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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## ACUTE STAPHYLOCOCCUS OSTEOMYELITIS

THE USE OF STAPHYLOCOCCUS ANTITOXIN AS AID TO MANAGEMENT OF TOXEMIA  
AND STAPHYLOCOCCI MIA

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**S**TAPHYLOCOCCI produce either a number of exotoxins or one exotoxin which has a variety of biological effects. A leucocidin was demonstrated by Van de Velde (31) in 1894, an hemolysin, by Kraus and Clairmont (19) in 1900 and by Neisser and Wechsberg (21) in 1901, a rapidly acting lethal toxin, by Kraus and Pribram (20) in 1906, and a dermal necrotizing toxin by Parker (27) in 1924. Subsequent studies by Nicolle and Cesari (23), Parker and Banzhof (28), Burnet (5), Gross (11), Panton and Valentine (24), Bigger, Boland, and O'Meara (1, 2), Burky (4), Combesco, Istrati and Combesco (6), Connor and McKie (7), Forssman (10), Nelis (22), Parish and Clark (26), Birch-Hirschfeld (3), Dolman (8), Jamieson and Powell (16), Weld and Gunther (32), Pike (29), Hartley and Smith (15) indicate that many strains of staphylococci produce all of these exotoxins and that the exotoxins from any one strain will stimulate the formation of antitoxin capable of neutralizing the toxins produced by any other strain of staphylococcus.

Encouraging results have been obtained with antitoxin treatment in a total of more than one hundred patients by Panton, Valentine, and Dix (25), Gross (12, 13, 14), Parish, and Clark (26), Dolman (9), and Keith (18).

The largest and best controlled series of cases was reported by Dolman.

Our interest in this problem began in 1932 with the isolation of a hemolytic *Staphylococcus aureus* from the throat of a patient dying with malignant neutropenia (Tolly strain). This organism produced leucocidins, hemolysins, dermal necrotizing toxins, and a lethal toxin which would kill rabbits in 3 to 10 minutes. Injections of graded doses of this toxin into rabbits over a period of 6 to 10 days resulted in a hyperplasia of the bone marrow (similar to that shown by the marrow of the patient), an increase in the non-segmented and a decrease in the segmented polymorphonuclear leucocytes of the circulating blood and a fluctuating neutropenia (17). Necropsies on the rabbits showed a cortical necrosis of the kidney (30).

After testing the potency of our toxin in over 150 rabbits under various conditions, we obtained a supply of staphylococcus antitoxin<sup>2</sup> prepared from the toxin produced by Burky's Ha strain of hemolytic *Staphylococcus aureus*. We found that this antitoxin protected completely 16 rabbits from the effects of multiple lethal doses of toxin from our original strain (Tolly) while 16 unprotected control animals died in from 3 to 15

<sup>2</sup>Product of Lederle Biological Laboratories

<sup>1</sup>Aided by the Henry Strong Denison Medical Foundation and the Bowman Gray Medical Research Fund



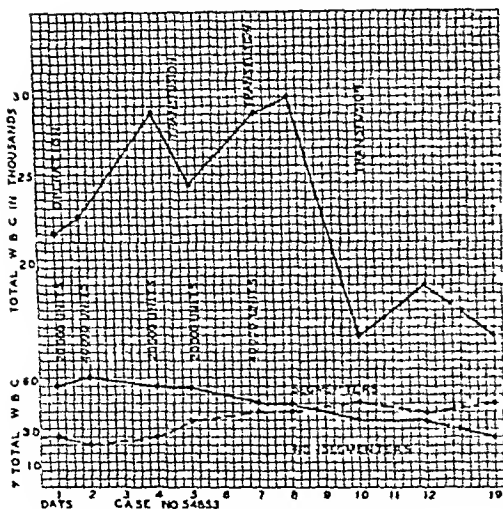


Fig 2 Case 54853 Shows hemogram of a 12 year old negro boy with acute osteomyelitis and staphylococemia. This patient had multiple foci of infection and required 140,000 units of antitoxin to produce a favorable hemogram

there was severe pain in the right hip associated with nausea, vomiting, chills, and fever

On examination she was found to be acutely ill, with increased heat, swelling, and tenderness in the region of the upper end of the femur. Excruciating pain was caused by motion of the right leg. She was given intramuscularly 35 cubic centimeters (20,000 P international units) of staphylococcus antitoxin (Lederle). Her condition remained about the same during the second day. On the third day, the infection in the right hip was incised and drained by Dr Randolph Jones. The blood cultures showed two colonies per cubic centimeter of hemolytic *Staphylococcus aureus*. Following the operation she was given 70 cubic centimeters (40,000 P international units) of antitoxin. She continued to have chills and her temperature varied from 39 to 41 degrees C so she was given another 70 cubic centimeters (40,000 P international units) on the fourth day and 35 cubic centimeters (20,000 P international units) on the fifth day. The blood picture showed a dramatic shift from 60 per cent non-segmented polymorphonuclear leucocytes and 15 per cent segmented leucocytes to 20 per cent non-segmented and 60 per cent segmented forms (Fig 3). The patient began to improve and the organisms disappeared from the blood although the temperature continued to fluctuate from 37.5 to 39.5 degrees C. Thirty days later she still had a chronic osteomyelitis with some fever and is being actively immunized with staphylococcus toxoid.

CASE 54853. R. J., negro boy, age 12, was admitted to the hospital July 3, 1935, complaining of pain and swelling in the right hip for 9 days. Following an injury to the right hip by a fall a diffuse

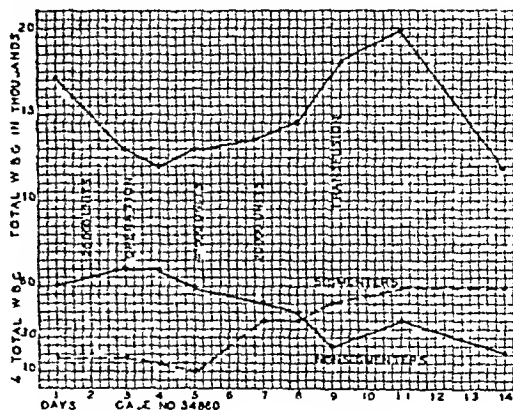


Fig 3 Case 54860 Shows hemogram of a 9 year old white girl with acute osteomyelitis and staphylococemia. This patient received about the average dosage of antitoxin (80,000 units). Note the favorable shift in the hemogram before transfusion

swelling which extended down to the knee appeared the next day. Fever, tenderness, anorexia, and malaise gradually increased up to time of admission.

Examination revealed an acutely ill, negro boy, crying with pain in the right leg. There was swelling, increased heat, and tenderness from the iliopectineal line to the knee of the right leg. There was also pain, swelling, and an increase in local heat over the middle toe of the left foot. He was given 35 cubic centimeters (20,000 P international units) of staphylococcus (Lederle) intramuscularly and then taken to the operating room where Dr H Shiebel incised and drained the disease process in the right thigh. The temperature varied from 39 to 41 degrees C and 70 cubic centimeters (40,000 P international units) of antitoxin was given on the second day. The blood cultures showed per cubic centimeter of blood five colonies of hemolytic *Staphylococcus aureus*. On the third day the blood picture showed a marked improvement with a shift from 60 per cent non-segmented polymorphonuclear leucocytes and 20 per cent segmented leucocytes to 30 per cent non-segmented and 55 per cent segmented forms (Fig 2).

He received 35 cubic centimeters (20,000 P international units) of antitoxin on the third day and a transfusion of blood. The middle toe on the left foot was incised and drained. During the next 4 days he received five small transfusions and a total of 140 cubic centimeters (80,000 P international units) of antitoxin. The hemoglobin which was 4 grams was raised to 7 grams by these transfusions. On the sixth day the patient developed marked edema of the scrotum and penis which was attributed to local lymphatic involvement although there was albumin in the urine and the blood chemistry studies showed a non-protein nitrogen of 120 milligrams per cent, and a reversal of the albumin globulin ratio. The temperature reached normal by the twenty-eighth day, and blood cultures have

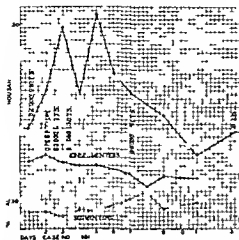


Fig. 4. Case 32092. Sh was a mogram for a year. A white boy who died of cut osteomyelitis with staphylococemia and pneumonia. With the help of the record of 350,000 u. the mogram made of the whole

remained sterile. The osteomyelitis is in the chronic stage but the urine still shows albumin and a few red blood cells and the patient has a generalized edema which is subsiding.

CASE 32092. H. M. R. white male age 22 years was admitted to the hospital on May 24, 1935 with the complaint of pain in the left ankle and fever for 6 days, chills, nausea and vomiting for 4 days. He was acutely ill with flushed face, mental drowsiness and marked tenderness, swelling, redness and increased heat over the lower end of the left tibia.

After a preliminary skin test he was given intramuscularly 40 cubic centimeters (32,000 I. International units) of staphylococcus antitoxin (Lederle). The following morning the site of the osteomyelitis was incised and drained by Dr. B. R. Ranev. Blood stream cultures and cultures from the pus from the tibia were positive for hemolytic *Staphylococcus aureus*. He received intramuscularly 100 cubic centimeters (80,000 I. International units) of antitoxin on the second day, 200 cubic centimeters of citrated blood and 100 cubic centimeters (80,000 I. International units) of antitoxin on the third day. The disease continued to progress and the temperature ranged from 39 to 41 degrees C. Substernal pain appeared on the fourth day and the roentgenogram showed a unilateral consolidation in the right and left lower lobes. Repeated blood cultures showed per cubic centimeter twenty to thirty colonies of hemolytic *Staphylococcus aureus*. By the seventh day the patient was practically moribund. At this time 100 cubic centimeters (80,000 I. International units) of antitoxin was mixed with equal parts of saline and given intravenously over a period of 1 hour and 30 minutes. The patient went to sleep while the injection was being given. The

temperature dropped to normal and remained within the normal limits for the next 8 hours and then rapidly rose to the former range of 39 to 40 degrees C. Jaundice appeared on the fourth day and gradually increased presenting a direct Van den Bergh of 4.7 milligrams per cent on the ninth day. Although the percentage of segmented polymorphonuclear leucocytes increased immediately after the intravenous antitoxin, the total white count steadily dropped to 5,200 (Fig. 4) and the respirations ceased on the thirteenth day.

Necropsy findings: Acute osteomyelitis of the left tibia. Multiple abscesses of both lungs, heart kidneys, anterior and posterior thoracic muscles. Peritonitis of the right clavicle and the left third and fourth ribs anteriorly. Hemorrhagic myocarditis, gastritis, enteritis and pyoarthritis of the right clavicula, sternal joint.

#### SUMMARY

These children with acute osteomyelitis and staphylococemia presented a picture of profound toxemia with chills, high fever, disproportionately high pulse rate, respiratory distress and sometimes delirium. Our experience is in accord with that of Dolman (9) who maintains that the majority of symptoms are due to the *in vivo* production of staphylococcus toxin and not to the presence of staphylococci in the circulating blood. The administration of antitoxin in sufficient amounts relieves the general symptoms although organisms persist for several days in the blood stream. The antitoxin is not directly bacteriocidal but has an indirect bacteriocidal action by neutralizing the circulating toxin and thus removing the inhibition of the normal phagocytic activity of the leucocytes. Our studies suggest that the mechanism is of major importance since those patients who lost toxic symptoms following administration of antitoxin all showed an increase in the white blood cell count with a return to a more normal ratio of segmented to non-segmented polymorphonuclear leucocytes. The patients who died showed a progressive disproportion of non-segmented to segmented leucocytes. It is more than likely that the toxin which produces this change in the leucocytes is also damaging other cells in the body. Certainly the segmented to non-segmented ratio seems to be a simple measure of the degree of toxemia and a convenient guide to the dose of antitoxin and frequency of its administration.

The dosage will vary with the severity of the disease with the duration of the disease before treatment and with the size of the patient. We have obtained good results with as little as 32,000 P international units and as much as 160,000 units. Prompt and adequate surgical drainage of all foci is absolutely essential since this prevents the absorption of additional toxin. Multiple blood transfusions are also indicated.

Eleven of our patients were given antitoxin intramuscularly without general serum reaction but practically all later developed serum sickness. In 1933 we administered antitoxin intravenously to two adult patients with staphylococcus infection, but no osteomyelitis. They both had severe serum shock. This corresponds to the experience of Dolman and Keith with the intravenous administration of antitoxin. We have always considered intravenous injections the ideal method of treatment if the danger of shock could be eliminated. Three recent patients have been treated intravenously with a highly refined and purified antitoxin resulting in only a mild chill and slight febrile reaction. The clinical improvement was dramatic with a drop in temperature, a rise in segmented polymorphonuclear leucocytes and a loss of general toxic symptoms.

#### CONCLUSIONS

1 The majority of the symptoms shown by children with acute osteomyelitis and staphylococcemia are due to *in vivo* production of toxin.

2 Commercial staphylococcus antitoxin will neutralize *in vitro* the exotoxins of heterogeneous strains of staphylococci.

3 The segmented non-segmented ratio of the polymorphonuclear leucocytes is an indication of the severity of the toxemia and a convenient guide to the dose of antitoxin and frequency of administration.

4 Sixteen patients with acute osteomyelitis and staphylococcemia treated by prompt drainage and multiple blood transfusions resulted in 8 deaths and an equal number of recoveries.

5 Thirteen patients with the same type of infection treated by the same method supple-

mented by the administration of staphylococcus antitoxin resulted in 2 deaths and 11 recoveries.

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# CYCLICAL CHANGES IN THE HUMAN VAGINAL MUCOSA

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IT was the physiologist, Ludwig, who enunciated the principle that changes in the function of body tissues are always associated with differences in structure. In the years which have followed the formulation of this thesis, students of morphology and physiology have found abundant evidence supporting it. The recent discoveries concerning the reproductive physiology of the female have been associated continuously with studies which reveal alterations in the finer structure of the generative organs in response to physiological stimuli. It has been demonstrated that the tissues of the uterine and tubal mucosa as well as those of the ovarian cortex and the adenohypophysis vary as regards their cellular content and arrangement so that they present histological pictures characteristic of the different stages of the ovarian cycle.

The mucosa of the fundus of the uterus and that of the oviduct have such a definite cellular response to the pituitary and ovarian cycles that one is able to diagnose from them the status of structures in the ovary with a great degree of certainty. It might be logical to assume, therefore, that other portions of the Muellerian duct, such as the cervix and vagina, might show evidence of rhythmic histological change in an analogous manner. Thus far, no study of the cervical epithelium of the woman from this point of view has appeared, although Hartmann and Olbers (1931) have drawn attention to the very definite cycle in the cervix of the guinea pig. On the other hand the search for a histological cycle in the vagina has engaged the attention of many workers, but unfortunately a wide divergence of opinion has resulted as a brief historical résumé will show.

Morau, in 1889, observed that the vaginal epithelium of rodents underwent structural changes under the influence of estrus and ovulation. These observations were confirmed by de Retterer, in 1892, and Lataste, in 1893. Their significance was not sensed,

however, until Stockard and Papanicolaou in 1917 again called attention to them and unmistakably correlated the cellular response of the guinea pig vagina to that in the ovary. These observers went further and demonstrated that smears made from the vaginal fluid and cell content of the vagina also revealed variations which were specific with regard to the phases of the ovarian cycle.

Stieve, in 1925, contributed his first study of the human vaginal epithelium from the point of view of cyclic change. Although he studied the mucosa of only two women, one of whom was sterile and possessed of an infantile uterus, he made the sweeping statement that there are no essential cyclical changes in the vaginal epithelium other than moderate hypertrophy and hyperplasia of the squamous cells, leucocytosis, and hyperemia during the premenstrual phase.

The year 1927 brought forth several studies of the human vagina. Dierks and Puccioni working independently, reported investigations in which the former observed 30 women and the latter, 20, all of whom were menstruating normally. Both agreed that there were definite rhythmic variations of the vaginal epithelium which could be correlated to the menstrual cycle. Dierks divided the epithelium into three layers, a functionalis or outer layer, an intra-epithelial hyalinized layer, and a basalis. The basalis, he concluded, is refractory, showing no change, while all of the functionalis and part of the zone of cornification are shed during menstruation. Puccioni differentiated between an intermenstrual, a premenstrual, and a menstrual phase of the vaginal cycle. In the first of these he thought the regeneration of the tissue to take place, while he considered the premenstruum to be characterized by strong proliferation, marked hyperemia, and the commencement of shedding. The latter he described as continuing during menstruation and then being followed by a phase of rest. Both of these observers based their



work upon a single biopsy from each patient taken from any convenient location which may be worthy of note in view of Stieve's later work as well as that which we shall present. In the same year Fraenkel and Fels corroborated most of Dierks' findings concerning the vaginal epithelium but were unable to correlate them with the ovarian cycle. We have no details as to their material or methods.

Since 1928 a great many contributions have been made to the subject with a majority of the observers unable to confirm the occurrence of the vaginal cycle. Stenishorn, Lindemann, Nuernberger, Lahm, Fels, Heynemann, Gihertz, Kuechen, Walther, Keller, and Schiller are among those who for the most part repudiated Dierks' work. On the other hand, Adler, Pankow, Esch, Dyroff, Davanzo, Vinos, and Geist, with Smith and Brunner, confirmed the existence of a vaginal cycle although all of them except Vinos did so with definite reservations. Stieve again studied the problem in 1931 and wrote two additional articles in which he adhered to the views he expressed in 1925. In addition he found he could attribute no importance to the zone of cornification as described by Dierks, pointing out that it is inconstant, being found in some locations and not in others, or that it can be found in any phase of the menstrual cycle as well as during pregnancy before puberty and after the menopause. Its presence, he felt, is dependent upon mechanical factors, certainly not upon endocrine relationships. Furthermore, he described similar cornifications in other parts of the body such as the buccal mucosa and the esophagus in male as well as female subjects.

In 1935, Davis and Hartmann studied the vaginal mucosa of the rhesus monkey by making biopsies from each animal at the same level of the vagina at weekly intervals. They were convinced that in this animal the vaginal epithelium responds in characteristic fashion to stimuli which coincide with the ovarian phases.

This brief review of the literature gives abundant evidence that the problem of rhythmic variation in the human vagina, though much studied, is far from being estab-

lished. We believe that this diversity of opinion has arisen from the application of faulty methods in that none of these observers of human material obtained any considerable number of biopsies from the same patient or observed the precaution of focusing their observations upon a definite location in the vagina. As Stieve and Pankow pointed out, there frequently are wide variations between the upper and lower portions of the same vagina at the same time. We feel therefore that there is need for further study of the subject and are particularly stimulated because of the recent demonstration of Papanicolaou proving that smear preparations of the human vagina have a characteristic variation in their cellular content which can be considered as specific for the various phases of the menstrual cycle. Inasmuch as the cells he describes in his studies concern leucocytes and young or old squamous epithelial cells, principally, it would seem almost certain that the variations as represented in smears of these cells must arise as a result of very definite fluctuations in the histological character of the vaginal mucosa.

#### MATERIAL AND TECHNIQUE

This study of the human vaginal mucosa is based upon specimens taken from 9 normally menstruating women who had no gynecological or endocrine condition which might vitiate the observations in so far as could be ascertained. In 12 of these women it was possible to secure 4 or more vaginal biopsies at weekly intervals so that in them a complete menstrual cycle is represented. From the 17 remaining patients, either a lesser number of specimens were secured or intervals longer than a week elapsed between the taking of biopsies. The conclusions of the study are based principally upon the former group while the second has been used as additional evidence only when time sequence or the lack of frequent observation did not seem important to the point under consideration. Although the patients were selected because they menstruated normally and because they were thought to be free of disease, a few developed some menstrual irregularity while under observation, whether as a result

TABLE I—TABULATION OF MEASUREMENTS—CASE 12\*

Number of biopsy		a	b	c	d	e	f
Day of cycle		16th	24th	31st	7th	14th	21st
Total epithelium—	Maximal height	300	400	200	370	400	290
	Minimal height	150	200	60	60	110	60
	Average height	230	240	150	180	210	160
Superficialis—	Maximal height	110	180	150	70	140	110
	Minimal height	20	30	20	3	16	15
	Average height	70	90	60	50	80	60
Basalis—	Maximal height	220	220	370	340	340	150
	Minimal height	100	20	20	30	20	15
	Average height	160	150	90	130	130	100
Loose zone—	Maximal height	110	180	80	70	140	110
	Minimal height	0	0	0	3	0	0
	Average height	60	80	40	35	70	50
Dense zone—	Maximal height	40	50	30	40	20	20
	Minimal height	0	0	0	0	0	0
	Average height	10	10	20	15	10	10
Light zone—	Maximal height	230	110	80	220	300	70
	Minimal height	20	0	0	0	10	0
	Average height	130	70	40	90	100	40
	Number of cell layers	6-10	0-8	0-5	0-11	1-20	1-6
	Average height of a single layer	16	14	14	15	14	14
Dark zone—	Maximal height	60	180	80	80	60	110
	Minimal height	15	40	20	10	10	15
	Average height	30	60	50	40	30	60
	Number of cell layers	2-6	4-16	3-9	1-7	1-7	3-12
	Average height of a single layer	8	7	8	9	8	7
Diameters of the larger cells of the light zone		60/18	40/18	30/18	40/18	30/11	30/11
Number of mitoses		0	0	0	0	0	0
Quantity of leucocytes—	Basalis	+	+++++	+++++	+++	+++	+++++
	Tunica propria	+	+++	+++	++	++	++
Hyperemia		None	Marked	Slight	None	None	Marked
Density of the tunica propria		Medium	Medium	Medium	Medium	Medium	Medium

\*An example of the method of measurement used in analyzing the various biopsy specimens. This woman had a menstrual cycle of 31 days so that 6 biopsies were necessary to complete the cycle. All measurements are in micra. A similar table was made for each of the 11 other women whose vaginas were observed in this study.

of the biopsies or not we are unable to decide. These minor irregularities have been taken into consideration, when they occurred, and the data from the case rejected or retained depending upon whether or not subsequent cycles were normal.

All biopsies were taken at the same level of the vagina. The sites chosen were on the

lateral walls, in the middle of the upper third of the vagina. The specimens were taken with an ordinary tissue rongeur and nearly always by the same operator. The procedure was painless and bleeding usually insignificant. The specimen, a round piece of tissue about 6 millimeters in diameter, was immediately placed in Bouin's solution for fixation.





Fig 1 Photomicrographs of biopsy specimens from the same vagina. The upper one was removed on the fifteenth day of the cycle and is in the inactive phase. The lower picture represents the proliferative phase and was removed on the fifth day of the cycle. a, Basalis, dark zone, b, light zone of basalis, c superficialis. The lower picture shows marked proliferation and increased height of the dark zone as compared to the upper one.  $\times 100$

eter always lies perpendicular to the lamina propria. This layer forms a definite dark ribbon of cells at the base of the epithelium and is frequently referred to as the stratum germinativum.

Superimposed on this single layer of the germinativum are four or five layers of larger cells, which are more irregular in disposition. The orientation of their nuclei is not uniform, but the nucleus itself presents the same appearance as those of the bottom layer. As the cells are larger, somewhat older, and not so closely packed, their affinity toward the basic stain is generally less marked. These together with the germinal layer have been designated as the dark zone of the basalis because they stain intensely with the basic hematoxylin dye.

In the light zone of the basalis, the cells are markedly larger than those of the dark zone and increase in size as the upper layers are reached. The outline of the cell has changed from oval or octagonal to a flat spindle contour. The cell membranes are more apparent and the protoplasm is vacuolated. The nuclei show evidences of degeneration which become more marked as the upper layers of the light

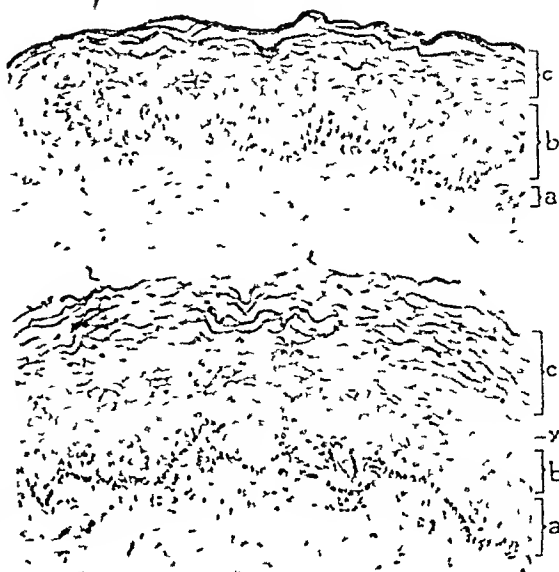


Fig 2 Upper, Inactive phase. Biopsy removed on the tenth day of cycle. Lower, Proliferation of basalis in same patient, biopsy removed on the seventeenth day. a, Basalis, dark zone, b, basalis light zone, c superficialis. d, Dierks' "zone of cornification".  $\times 100$

zone are approached. They stain less deeply with hematoxylin and their chromatin is shrunk to form a small, irregular spot in the center of the large nucleus. This transition from the lower to the upper layers is usually progressive and the cellular changes are interpreted as depicting the gradual death of the cells.

In the superficialis the process of stratification and cornification takes place. There is a very abrupt change from the basalis to the superficialis. The cells of the latter take almost none of the hematoxylin stain and are, for the most part, quite loose in their arrangement. Occasional areas of dense or compact arrangement are frequently observed and when present may be in any part of the superficialis. It is this latter occurrence which Dierks and others have alluded to as "intra-epithelial zone of cornification" (Fig 2).

Dierks considered that the appearance of his "intra-epithelial zone of cornification" was a symbol of ovarian hormone effect and that it was characteristic of the premenstrual phase. As has been pointed out in the discussion of the literature, many authors have



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found this histological picture in the vaginal epithelium of individuals previous to puberty and after the menopause. Stieve has also shown that such cornification may occur in the buccal and esophageal mucosa. All this evidence seems to indicate a lack of specificity in this epithelial reaction. On the other hand there is no agreement among other authors that this represents real cornification. One of this group, Stemshorn, therefore proposes the use of the term "area of densification."

#### DESCRIPTION OF THE VAGINAL EPITHELIUM DURING THE PROLIFERATIVE PHASE

As the outstanding and only constant histological variation possessed of a rhythmic nature we have observed a proliferative phase which usually begins in the premenstruum. This phase is characterized by a proliferation of the young cells in the dark zone of the basalis and results in enlargement of the papillae both in breadth and depth so that there is marked increase in irregularity of the



Fig 5 Patient 12 Thirty first d y f cycle Prol f  
t phase 1 g ess e D k zo b sal b h hbt  
zon b sal s p e f l X90



Fig 4 Pat 12 Two ty f rth day f ycl Pro  
liferative phase D k zon f b sal hyp rpl t c e  
co g sted blood essels b X90

margin between the basalis and lamina propria. Mitoses are only rarely observed. At the same time there is a marked increase in height of this zone. The growth period may or may not be accompanied by changes in the more peripheral layers. We have been unable to discern any constancy in reaction above the dark zone of the basalis. However more or less synchronous with the proliferative activity we have observed dilatation and increased numbers of blood capillaries (Fig 4) associated with an infiltration of leucocytes which invade the tunica propria and the epithelium. Such leucocytes never disappear completely during any phase of the menstrual cycle but their numbers undergo variation with a tendency for the maximum to occur at the period of proliferation.

Unfortunately from a theoretical point of view the incidence of the proliferative phase in the vagina is somewhat variable with respect to the menses. However in the majority of our subjects it occurred between the twenty first and the seventh days of the cycle thus seeming to coincide roughly with the menstrual period. The proliferative phase covers several days beginning and ending gradually. The biopsies do not always coincide with its maximum development some times showing the ascending process while others show it on the wane. If one were to demonstrate the beginning maximum development and end of the process it would



FIG. 4. Patient 10. Twenty-first day of cycle. The upper part of the superficialis is occupied by the hyperplastic zone.



FIG. 5. Patient 10. Twenty-first day of cycle. The upper part of the superficialis is occupied by the inflammatory stroma, dark cells.  $\times 62$ .

probably be necessary to take into account not only the amount of direct displacement, but also the displacement of the superficialis. Several of our patients exhibited the proliferative phase as a periodic menstrual phenomenon, while others began perimenstrually and ended during menstruation, and others into the postmenstruum.

Some authors have concluded hyperplasia of the vaginal mucosa just before and during menstruation. Our observations show that the hyperplasia is not related to menstruation but to the proliferative phase. In those subjects in which the proliferative phase was terminated before menstruation, there was no observable hyperplasia during the menses. On the other hand, in the patients in whom the proliferative phase extended into postmenstruum, hyperplasia was definite.

Numerous biopsies made from the vaginas of pregnant women have not revealed the proliferative phase as we have described it. On the other hand, the quiescent appearance of the mucosa is not seen. It could seem that during pregnancy the renewal of the vaginal epithelium occurs continuously instead of periodically, as in the non-pregnant state. The histological picture in all stages of pregnancy might be characterized as subproliferative in type.

#### DISCUSSION OF CONTROVERSIAL POINTS

Our observations concerning the dense zone of the superficialis (zone of cornification) do not confirm the descriptions of Dierks, Adler, Davanzo, and others. This phenomenon, when observable, presents marked variations of height and appearance, not only is be-

low in some patients and the vagina hangs off from the os per partum, but also with regard to an exact portion of the vagina in which a proliferation of the superficialis is to be observed. It is impossible for us to substantiate whether the problem is related exclusively to the vagina, which must be correlated with the menstrual cycle.

In the lower part of the superficialis, no observations though not definite, are equally negative. We still insist on it with the deductions of these authors, although variations in height correspond to the vaginal phase of menstruation. In some instances we found that the zone was high in the premenstruum and low or nearly absent after the menses. However, quite the contrary was just as frequently seen. The variations in the respect even of a single individual were often marked and served to make comparison difficult. However, we conclude that in most cases the variations of the superficialis seem to be without relation to the phase of the menstrual cycle. The same may be stated for the variations in the total height of the epithelium.



FIG. 6. Patient 10. Twenty-first day of cycle. The upper part of the superficialis is occupied by the inflammatory stroma, dark cells.  $\times 62$ .







A HISTOLOGICAL STUDY IN TWENTY FOUR CASES OF  
RETAINED TESTES IN THE ADULTJOHN M. PACE, M.D., ROCHESTER, MINNESOTA  
Fellow University of MinnesotaHUGH CABOT, M.D., F.A.C.S., ROCHESTER, MINNESOTA  
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THE work of Moore (1, 2, 3, 4) and Wangersteen and others has shown that in animals the development of the testis depends very much upon its occupying a normal position in the scrotum. Although there is little evidence upon the point other than that derived from experimental studies on animals, it seems fairly certain that these observations ought to be translated into action in the treatment of the cryptorchid. It is now generally recognized that in children the testis must be made to lie in a wholly normal position at the bottom of the scrotum if the best opportunity for proper development is to be obtained. On the other hand, much difference of opinion still exists as to the proper treatment of the adult cryptorchid.

The experimental evidence at least suggests that the abnormally placed testis if allowed to go into adult life in its malposition may have been so thoroughly damaged that no regenerative process can be expected. Opposed to this are the frequent reports in isolated cases of the histological examination of the retained adult testis showing in some areas almost normal tubules and in others tubules which might conceivably show regeneration. For example, de Winwarter (6, 7) examining two specimens of undescended testes obtained respectively from patients of 23 and 40 years of age expressed the opinion that the epithelium of the tubules was sufficiently preserved so that the possibility of regeneration to a normal condition could not properly be denied.

In our series we were concerned with the question of whether the degeneration shown in these retained testes was in general progressive so that in the earlier decades the state of the epithelium would be such as to suggest the possibility of regeneration if

placed under normal conditions and whether in the later decades the degeneration had gone so far as to constitute practically complete atrophy.

We were also concerned with the still disputed question of the frequency of malignant disease developing in the abnormally placed testis. The weight of opinion appears to favor strongly the view that such malignant processes are importantly more common in the retained testis. In none of the patients with whom we were concerned did the testes, which were removed practically always in order to facilitate the cure of a hernia, show any gross evidence of malignant change. In none of them was the possibility of cancer entertained by the surgeon at the time of operation, but in 3 cases evidence of malignant disease was found by us.

## ABSTRACT OF HISTOLOGICAL FINDINGS

No specimens were included in which the patient had not passed puberty.

**Second and fourth CASE.** The patient was white, single, and 18 years of age. The testis was in the right inguinal canal. On microscopic examination only remnants of testicular tissue were seen showing atrophic tubules with a very faint basement membrane. No germinal epithelium as found.

**CASE.** The patient was single, white, and 19 years of age. The testis was in the external ring. On microscopic examination the tunica albuginea was not abnormally thickened. The basement membrane of the seminiferous tubules was thick with slight atrophy of the germinal epithelium. An inflammatory troma was noted with increase in the fibrous connective tissue (Fig. 1).

In the first case only remnants of testicular tissue were seen and it should be remembered that this was in an 18 year old boy. It is very doubtful whether this testis if placed in the scrotum would ever have developed a mature germinal epithelium.



Fig 8 The tubules are hyalinized  $\times 35$

In Case 14 there was some atrophy and inflammation in the interstitial tissue. In Case 15 there was just beginning atrophy of the tubules. It is possible that the epithelium in Cases 14 and 15 might have developed had the testes been placed within the scrotum. Case 15 was the most promising. In Case 16 the tubules were hyalinized. With hyalinization as seen in Case 16 it would seem very improbable that spermatogenesis could ever occur in this organ. In Case 17 the tubules were markedly atrophied. There were hyper-



Fig 9 Fibrosis and hyalinization of the tubules  $\times 40$

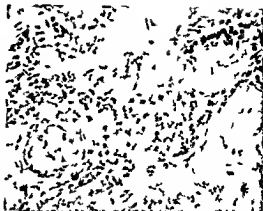


Fig 10 Interstitial cells in the tubular spaces which are partially differentiated into Leydig cells  $\times 40$

plastic interstitial cells of unknown function and of questionable morphology which would make its removal justifiable.

*Sixth decade* CASE 18. The patient was white married and 52 years of age. The testis was in the left inguinal canal. On microscopic examination the testis was found to be composed of fibrous connective tissue and adipose tissue. No remaining tubules were seen.

CASE 19. The patient was white married a 52 years of age. The testis was in the right inguinal canal. On microscopic examination the basement membrane of all of the tubules was found to be thickened and there were fibrosis and hyalinization of the majority of the tubules. An occasional interstitial cell was seen (Fig 10).

The microscopic appearance of the testis in Case 18 was essentially that of fibrous connective tissue with no tubules remaining. In Case 19 the tubules of the testis were largely fibrosed and replaced with hyaline tissue. It seems improbable that either of these testes would ever regenerate a functional germinal epithelium regardless of the position.

*Seventh decade* CASE 20. The patient was white married and 62 years of age. The testis was at the left external inguinal ring. Microscopic examination revealed that the tubules were atrophied and almost completely hyalinized. No interstitial cells were seen. The stroma was slightly edematous.

CASE 21. The patient was white married a 62 years of age. The testis was in the right inguinal canal. On microscopic examination the tubules

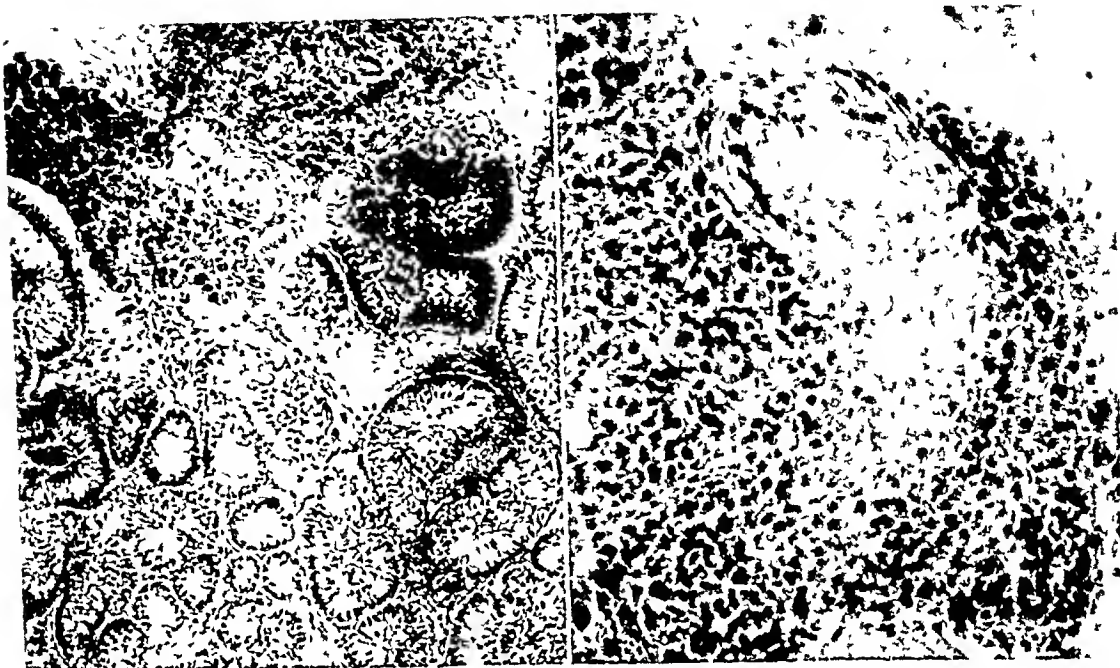


Fig 11 a, left Hyperplasia or early cancer of tubules. In the upper portion of the illustration is seen a mass of interstitial cells of questionable morphology. In the upper left hand corner are interstitial cells with larger nucleoli and

brown pigment  $\times 100$  b, Higher magnification of a different field of the same specimen. Interstitial cells with large nucleoli which apparently originate in the tubules  $\times 230$

were found to be replaced with fibrous connective tissue and hyaline. The tubular outlines were recognizable but entirely devoid of any epithelium. No interstitial cells were seen. The stroma contained some inflammatory cells.

**CASE 22** The patient was white, married, and 62 years of age. The testis was in the left inguinal canal. On microscopic examination the tubules were seen to be replaced with hyaline. A few interstitial cells remained. There was a chronic interstitial inflammatory reaction.

**CASE 23** The patient was white, married, and 65 years of age. The testis was in the left inguinal canal. On microscopic examination the testis was found to be completely replaced with fibrous connective tissue with areas of hyalinization. No tubular outlines remained.

**CASE 24** The patient was white, married, and 67 years of age. The testis was retained in the abdomen on the right. Microscopic examination revealed the tunica albuginea, walls of the blood vessels, and the basement membrane of the tubules to be thickened. The interstitial cells were reduced in number in some areas and were seen as hyperplastic masses in other areas (Fig 11a). In the midportion of the testis, well removed from the surface, was seen what was in the opinion of two pathologists an early adenocarcinoma. Another pathologist, in examining this area, was unwilling to call these cells truly cancerous, but it was undeniable in his opinion that

they represented the extreme of hyperplasia. Furthermore, he regarded another group of apparently interstitial cells as being malignant, and he demonstrated one field in which it would seem that the origin of these cells was in the tubules (Fig 11b).

In Cases 20, 21, 22, and 23 fibrosis and varying degrees of hyalinization of the tubules were noted, and it is inconceivable that these four testes should have regained their normal spermatogenic function had they been placed in the scrotum. In Case 24 is seen what is regarded by two pathologists as adenocarcinoma, grade 1. However, this diagnosis was not in accord with the opinion of the third pathologist, who considered this questionable area of tubules to be hyperplastic. Two pathologists regarded the hyperplastic whorls of interstitial cells as not being malignant, although one of the two went so far as to say that these interstitial cells may be regarded by some as precancerous. The third pathologist was very definite in stating that he regarded these interstitial cells as being malignant, and he demonstrated to our satisfaction that their

origin was tubular. He described the lesion as being a spermatoblastoma.

#### SUMMARY

This study seems to suggest that there is progressive deterioration as the years go by. Thus in the second decade one specimen showed germinal epithelium which might have developed normally. The other case showed very complete degeneration and it is not improbable that this was an undeveloped testis from the start. In the third decade all of the 6 specimens showed some degree of atrophy but all showed remaining epithelium which could have gone on to satisfactory development. In the fourth decade 4 of the 5 specimens showed epithelium which might have developed normally. The fifth specimen showed very extensive atrophy. In the fifth decade 2 of the 3 specimens showed epithelium which might have developed while the 2 others had gone on to very complete destruction. One of these was a testis retained within the abdomen in which on theoretical grounds one would expect more complete atrophy. In the sixth decade both of the specimens showed very complete fibrosis and destruction. It did not seem reasonable to assume that these could show any important degree of regeneration. In the seventh decade all of the 5 specimens showed extensive degeneration and hyalinization and were apparently beyond recall. Attention is called to the absence of hyperplasia of the interstitial cells of Leydig except in figures 9 and 11a.

#### EVIDENCE OF MALIGNANT DISEASE

It is interesting and we think important to note that in the normal routine examina-

tion of these 24 specimens 3 were found which showed evidence of cancer. Two of these were in the third decade and showed a lesion described as adenocarcinoma. The third was in the seventh decade and showed a lesion which was more controversial. Two pathologists regarded the lesion as early adenocarcinoma. With this opinion the other pathologist disagreed however regarding the cells as showing abnormal hyperplasia.

These findings seemed to us very importantly to strengthen the opinion that the abnormally placed testis is much more likely to develop cancer than the normally placed testis. It further suggests that rather more careful study of misplaced testes removed at operation or found at autopsy might shed still more light upon this question which is of great importance.

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## PREVENTION OF RECURRENT RENAL CALCULI

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A SURVEY of the literature reveals a paucity of publications devoted to the problem of recurrent renal lithiasis following conservative operative intervention.

That calculi should recur frequently seems obvious when the initiating causes of stone formation are not corrected by the surgical removal of a calculus. Certainly, we are treating the "effect" and not the "cause" of this pathological condition. It is true that a calculus may be removed surgically or a small stone may be expelled spontaneously and that a recurrence may never be experienced, however, a sufficient number of cases of recurrence of stones has been reported to make a consideration of this problem of utmost importance, and it becomes obvious that before permanent relief from calculi may be secured, the underlying causes must be corrected and the factors eliminated which frequently are associated with the production of urinary calculi.

## CLASSIFICATION

Herbst classifies recurrent calculi in the following manner:

1 True recurrence or the new formation of a calculus after the complete removal of the original stone (Fig 1)

2 False recurrence or a persistence of stones or fragments of a calculus which were overlooked at the time of operation (Figs 2 and 3)

## INCIDENCE

It is difficult to estimate the true incidence of recurrent calculi. Unless a roentgenogram is made routinely following operation, a misinterpretation of results will occur, and it becomes impossible later to differentiate between a newly formed calculus and one which was overlooked at the time of operation.

It is true also that minute fragments of a stone or sand may not be demonstrated in a postoperative roentgenogram, although they may serve as nuclei for further stone formation. However, by placing a small film behind the delivered kidney for roentgenographic

study as suggested by Qunby or by fluoroscopic examination as described by Braasch and Carman, the presence of small stones or retained fragments frequently may be revealed, and these may be removed before the operation is completed. In a review of the cases of calculi recurring after operation for renal stones since 1917 at the Mayo Clinic, Braasch found that shadows of stones were present in the kidney in roentgenograms made immediately after operation in 31 of 685 cases.

The frequency with which calculi recur following operation varies considerably according to different authors. In 1915, Cabot and Crabtree, in reviewing the results of a series of operations for renal stone in Massachusetts General Hospital, stated that "recurrence" occurred in 56 per cent of patients treated by



Fig 1 True recurrent bilateral calculi



Fig. 1. Ureteral calculus in the right kidney. The largest calculus was in the distal portion (March 2, 1934) but the thickness of the wall was not looked.



Fig. 3. False recurrent calculus in the right kidney (December 4, 1934) the largest mass of calculus in the pelvis.

nephrotomy and in 51 per cent of those treated by pyelotomy. Brongersma reported the incidence of recurrence to be about 16 per cent in instances in which infection of the kidney was not present or in which only a slight infection was noted. In his series in which severe infection of the kidney was present recurrence occurred in about 30 per cent of the patients following operation.

Barney in 1922 reviewed the results secured in a series of patients operated upon for renal stone at the Massachusetts General Hospital and reported recurrence in 32 per cent of the cases. Of this group however postoperative roentgenograms were made in 20 cases and a stone still was present in the kidney in 9 or 45 per cent. Braasch and Foulds in 1924 stated that calculi recurred in 10.9 per cent of patients who were operated upon for renal calculi at the Mayo Clinic and Herbst noted a recurrence of approximately 15 per cent. In 1927 Hunner (13) reviewed the results secured in his series and stated that recurrence followed 9.5 per cent of operations for renal and 4.4 per cent of operations for

ureteral stones. In our series of cases from 1923 to 1932 a recurrence of 16.4 per cent has been noted. Thus it is evident that recurrent calculous formation is a complication which cannot be considered lightly and the empirical measures employed in the past did not prevent recurrence in from 10 to 15 per cent of the cases.

Frequently the prolonged presence of the calculus in the kidney has produced marked impairment of renal function, a superimposed renal infection, marked hydronephrosis or pyonephrosis which contraindicates a conservative operation. However if the kidney on the opposite side is normal when nephrectomy is performed the development of a calculus in the sound kidney occurs relatively infrequently. In his statistical study Rossing found that calculi developed in the sound kidney after removal of the pathological kidney only once following 31 nephrectomies. In our series of cases stones formed in the opposite kidney in 2.8 per cent of the cases.

The formation of calculi in the opposite kidney, therefore, occurs quite infrequently following nephrectomy—approximately in from 2 to 4 per cent of the cases

The type and consistency of calculus i.e. large or small, soft or hard, also influence the percentage of formation of calculi following operation. The larger percentage of recurrence following the removal of soft stones undoubtedly is due to retained sand or fragments and cannot therefore, be termed true recurrence

In the cases in which the stones extend into the calyces, a higher percentage of recurrences was noted in our cases than when the stone was confined to the pelvis itself. As in this group incomplete removal of the calculus may occur or damage to the calyx, infundibulum or renal pelvis may be instrumental in the production of the higher incidence of recurrence. Braasch (5) has stated that recurrence following removal of small stones exceeded that following large ones, 13.48 and 9.66 per cent, respectively. In our cases, if we included in the group of large calculi those which extended into the calyces, the percentage of recurrence, 17.98 per cent, is approximately the same provided the postoperative roentgenogram did not reveal retained calculi

The operative results in cases of bilateral calculi are not as satisfactory from the viewpoint of recurrence. In the large percentage of cases, bilateral infection is present, and Joly states that the infection usually persists following operation and recurrence is the rule. Brongersma reported 36 cases in which 75 operations were performed, and recurrences developed in 14 instances. Braasch (5) has stated that in most cases, the probable period of time is limited in which stones may form again, and the average interval between operation and recurrence is 2 years. However, in many instances, recurrences will develop at a later period, especially in patients between the ages of 20 and 40 years, and in some instances, small calculi will be passed spontaneously

#### FACTORS ASSOCIATED WITH FORMATION OF CALCULI

In the consideration of the prevention of formation of calculi, obviously the factors as-

sociated with their formation must be considered

*Infection* Keyser in reviewing a series of 12 cases of intensive recurrent lithiasis at the Mayo Clinic, noted positive cultures from the bladder in 6 cases, negative culture in 1 case, and in 5 cases no culture was reported.

Rovsing expressed the opinion that a urea splitting organism, especially the staphylococcus was most frequently associated with recurrent calculi. Braasch (5), however, states, 'Gross evidence of tissue infection did not seem to be a factor favoring recurrence. In fact the percentage of recurrence was less than average when the areas of renal infection were thoroughly drained and all fragments cleanly removed'

One of the most critically and carefully studied series of cases is that of Bugbee, who reviewed the results of operations for nephrolithiasis. This investigation was made to determine the presence or a pre-existing pyelonephritis as a possible factor in the formation of renal calculi. A definite history of pyelonephritis was elicited in 23 cases and in 17 treatment had been administered during the initial attack. In the 6 remaining cases, the infection had been treated by other physicians. Although roentgenograms did not demonstrate the presence of a calculus at the time when each patient was first seen, stones subsequently developed in all these patients. The reaction of the urine and the organisms cultured were noted in each case at the time of the original attack and during the subsequent attacks, and finally the composition of the calculi was determined. It is of interest to note that the urine was acid in reaction and that colon bacilli were the offending organisms in 16 cases during the first attack. In 9 of the 16 cases, the urine later became alkaline and staphylococci were the predominating organisms, in 5 the urine remained alkaline through repeated attacks, in 1 case, the urine was neutral in reaction and in another, it varied from faintly acid to neutral. The composition of the calculi formed in the presence of acid urine was calcium oxalate; in alkaline urine, largely phosphatic

The studies of Rovsing showed that 68.18 per cent of all recurrences occurred in kidneys

which were infected either primarily or secondarily with bacteria decomposing urea. In 15.9 per cent of cases recurrences developed in sterile urine.

True recurrence is relatively infrequent in aseptic kidneys or in those infected with *Bacillus coli* alone but when the urea splitting organisms are present especially the proteus organisms calculi develop or recur with considerable rapidity, enlarge rapidly and eventually destroy the kidney. Rosenow and Meisser also emphasized the part played by bacteria in the production of urinary calculi and its relationship to recurrent formation of calculi. They demonstrated the selective action of the green streptococcus in the formation of calculi.

**Hyperparathyroidism** Studies which demonstrate the relationship between the parathyroid glands and the formation of calculi have been reported by Albright and Bloomberg (1) Barney (3) Chute (10) and others. Albright recently reported a series of 23 proved cases of hyperparathyroidism from Massachusetts General Hospital in which X-ray studies revealed renal calculi in 15 patients. Examination of the blood in cases of hyperparathyroidism reveals a high level of serum calcium, a low level of serum phosphorus and an increase in the elimination of the calcium and phosphorus in the urine. Roentgenograms may reveal the presence of bone disease but in Albright's series evidence of bone disease without a coexisting renal disease was present in only 3 patients and he states that the findings in these cases suggest that renal disease is a more frequent manifestation of hyperparathyroidism than is bone disease.

If the calculi in a particular case are associated with hyperparathyroidism the surgical removal of the calculus from the kidney probably will be followed by recurrence of the stones. Therefore this condition must be treated before removal of the calculus is performed except in those exceptional cases in which delay in the operation is contraindicated.

**Cystinuria** Cystine nephrolithiasis is a more unusual type of calculous formation. Seeger and Kearns stated that since Wollas-

ton's discovery of cystine in 1810 (28) 181 cases of cystinuria have been reported and it is interesting to note that in 124 of the calculi have also been present.

Cystinuria is now believed to be due to an error in metabolism which Neuberg classified as follows:

- 1 The mild type in which there is a tolerance for tyrosin, cystine and asparaginic acid.
- 2 The type in which cystine is excreted and there is present also a diminished power to oxidize the other amino acids on feeding.
- 3 The type in which the disturbance of the intermediate protein metabolism is so advanced that other amino acids (tyrosin and leucin) are excreted as well as cystine.

Heredity is an important factor and several authors have reported the occurrence of cystine calculi in more than one member of a family.

The presence of cystine crystals or the presence of cystine in solution in the urine should draw attention to the fact that the calculus may be composed chiefly of cystine. However the substance may not always be noted in the urine of patients with cystine calculi and its disappearance from the urine at intervals has been observed. In this type of case restriction of proteins is advisable in conjunction with high vitamin A alkaline ash diet to prevent recurrence.

**Phosphaturia** Increased elimination of oxalates and uric acid in the urine as well as persistent phosphaturia are associated with calculous formation and therefore present an important problem in the prevention of stone formation. This is especially true in the patient with phosphaturia and while it is also recognized that infection probably is the most frequent cause of persistent phosphaturia this is not true in all cases.

Laidley states that three types of phosphaturia may occur:

- 1 Temporary phosphaturia
- 2 Permanent non infected phosphaturia
- 3 Permanent infected phosphaturia

Temporary phosphaturia may be caused by various metabolic factors. Laidley states that a constant finding in temporary phosphaturia is an increase in the total amount of alkali of the body fluids. The urine may become alkali-



line temporarily due to the ingestion of various foods, such as oranges, lemons, and other citrous fruits, as Holmes and Coplan have reported. Certain other foods yield an acid rather than an alkaline ash.

Permanent phosphaturia which is not associated with infection may coexist with a disturbance of the function of the large bowel, and in such cases, the usual amount of earthy phosphates may not be excreted. Laidley has found in his cases that there was an absolute and relative increase in earthy phosphates in the urine of permanent non-infected phosphaturia in contrast to the phosphaturia due to infection in which the earthy and alkaline phosphates eliminated in the urine were within normal limits.

Phosphaturia accompanied by infection is due to a deposition of phosphates by the urea splitting organisms which so frequently are associated with recurrent calculi. Thus, the urine of all patients with renal calculi should be cultured and it should be determined whether the organism has the power of splitting urea.

*Oxaluria* Neville has stated that an important factor in the production of oxaluria appears to be a disturbance of the calcium-phosphorus ratio which results in an excessive excretion of calcium which, associated with a deficiency in vitamins B and D, comprises but one symptom of general metabolic disorder. According to this writer, when disturbance of the calcium-phosphorus ratio is the immediate cause of oxaluria, this condition may be corrected by the administration of the deficient vitamins. Braithwaite cited the case of a boy in whom hematuria was associated with the passage of typical oxalate crystals in the urine. Under dietary management, the oxalate crystals disappeared from the urine and hematuria no longer occurred. Mitchell likewise cited the case of a student who passed enormous amounts of oxalate crystals in the urine and these disappeared after dietary management. The oxalate radical is derived mainly from the food, but occasionally oxalic acid may be formed in the intestines from excessive fermentation.

*Uric acid* Normally, from 0.3 to 1.2 grams of uric acid are excreted daily, this amount,

however, depending largely upon the diet. In the presence of lithiasis, tiny crystals of uric acid or urates which are derived from exogenous or endogenous sources or both may be noted in the voided urine. The exogenous source of uric acid is from the food, and especially from the purine bodies which are derived from the nucleo-albumin which is present in large amounts in kidneys, pancreas, and liver. The endogenous uric acid is derived from substances which result from the breakdown of cellular tissues.

*Vitamin A deficiency* In a series of 16 cases of nephrolithiasis which we have studied recently, we have found a positive Jean's test (a test for vitamin A deficiency) in 11. In 2 additional cases, carotene in oil capsules had been prescribed 2 months previous to our examination so the test gave normal findings. In one case in which hyperparathyroidism was associated with bilateral renal calculi, a positive test for vitamin A deficiency was found. Similar results are being noted in other cases of renal calculi, but as yet the test has not been performed upon a sufficient number of patients to warrant definite conclusions. In view of the experimental work reported previously on the production of urinary calculi by a diet deficient in vitamin A (12) and their solution by restoration of vitamin A to the diet, we believe that a Jean's test should be made in all cases of renal calculi.

Vitamin A is prescribed not only to overcome the vitamin deficiency present, but also because of its specific effect upon the epithelial cells. In some instances, loss of the epithelium of the renal pelvis is so complete that ulceration has occurred which is due to the constant trauma of the tissue by the calculus. On several occasions, at the time of removal of a calculus from the kidney, I have removed for study a small piece of the kidney pelvis contiguous to the calculus. In 3 instances the ulcerated area was covered with phosphates and minute calculi and sand. The fibrin coming from the ulcerated area formed a network to which the phosphates adhered and enlargement occurred by further deposition of phosphates at this site. Thus, in the presence of phosphaturia, the sediment and crystals may adhere at the point of ulceration, and fibrin

binds the particles together. This small accumulation of phosphates may then be expelled spontaneously or it may drop into the dependent lower calyx and enlarge by further deposition on the minute calculus. In the presence of urea splitting organisms the calculus enlarges rapidly. Similarly in the presence of uric acid crystals or urates in the urine oxaluria or cystinuria the respective crystals or sediment may adhere to a local lesion in the kidney whether it be due to trauma, vitamin A deficiency or infection and thus be instrumental in the production of calculi having these chemical constituents. No medication is comparable to vitamin A in its healing effect postoperatively on the epithelium of the kidney pelvis and it should therefore be prescribed routinely.

From a consideration of these factors which are of importance in the formation of calculi and with the knowledge that most of them may be controlled by dietary measures it is apparent that dietary supervision following operation is of inestimable value in the prevention of the recurrence of stones. It is imperative that crystals and sediment of oxalates, uric acid, cystine and phosphates be eliminated from the urine.

In the experimental laboratory we are now able to produce stones composed first of calcium and magnesium phosphate, second of calcium carbonate and finally of uric acid. *The composition of the calculi varies with the reaction of the urine, the sediment and the type of crystals present.* This finding again emphasizes the necessity for the postoperative elimination of the cause of any crystal formation in the urine by the use of proper diet and medication.

#### PRE OPERATIVE INVESTIGATION

A most thorough examination is essential in all cases whether renal calculi be primary or secondary. I have employed the following routine for the past 3 years. A careful history regarding the diet is essential to the discovery of any gross deficiency in the diet of the patient. Moderate degrees of deficiency in vitamin A cannot be determined from the history alone and in this regard it is important to remember that the vitamin A content of dairy

products varies considerably with the season of the year. An interesting study in this regard was that of the Ohio Experimental Station in which they found that when cows are on winter feeding some milk contains less than half as much vitamin A as when the cows are on summer feeding in pasture. Thus one of the chief sources of vitamin A which is contained in milk, butter and cream is altered considerably during the winter months. Likewise eggs toward the end of the laying season frequently contain only half the vitamin A content that they do in the earlier part of the year.

Familial history of calculi may be elicited as has been noted in cases of cystine lithiasis. A thorough physical examination should be made which includes a careful examination of the neck to discover the presence of a parathyroid tumor.

A plain roentgenogram is taken to determine the presence of a calculus in the kidney to ascertain whether bilateral calculi are present and whether coexisting stones are present in the ureters or bladder. This is followed by a cystoscopic examination. After examination of the bladder catheters are passed to both kidney pelves and specimens of urine from each are collected for routine examination for determination of the hydrogen ion concentration, culture, stained smear of the sediment and examination of the type of crystals which may be present. This is followed by a fractional phenolsulphonphthalein test. Pyelograms may be made at this time.

The following day after the spasm of the ureters due to the passing of ureteral catheters has subsided an intravenous urogram is done. From the urogram further evidence of renal function is secured and it may be determined whether or not the calculus is producing an obstruction to the passage of urine from the kidney. This also will reveal in most instances whether stasis due to stricture of the ureter is present. The urogram is of the utmost value in determining whether the patient should be treated conservatively by dietary measures or whether surgical intervention is required. Routinely blood sugar, urea creatinin, calcium, phosphorus, uric acid and phosphatase determinations are secured. It is

extremely important that a hydrogen-ion concentration determination be made of the urine from each kidney. Frequently, the hydrogen-ion concentration of the bladder urine is not an accurate index of the hydrogen-ion concentration of the urine from each kidney. I have seen several cases in which the hydrogen-ion concentration of the urine from a kidney which contained a calculus—especially of the phosphatic type or when an infection due to the urea-splitting organism was present—had an alkaline reaction with a hydrogen-ion concentration of 7.8 or 8, while on the opposite, normal side, the hydrogen-ion concentration was from 4.6 to 4.8. Since a normal kidney has better function and is eliminating more urine than the pathological kidney, the reaction of the urine in the bladder may be acid and may have a hydrogen-ion concentration value of from 5 to 5.4. Thus, an erroneous conclusion may be drawn regarding the true reaction of the urine from the kidney which contains the stone (Table I).

A study of the stained smear is required because in the culture, the cocci may be overgrown by a coexisting colon bacillus infection, while in the stained smear, the staphylococci are discernible. In suspected cases of hyperparathyroidism, the urine should also be studied for an increased elimination of calcium and phosphorus. Complete blood chemistry studies are essential.

If an elevation of the serum calcium and a lowering of the serum phosphorus be present, further studies are necessary to rule out the presence of hyperparathyroidism and roentgen studies of the bones are most important. Likewise, if there is an elevation of the blood uric acid, the purines in the diet must be minimized.

Finally, if a small stone has been passed spontaneously or if one which has been removed surgically is available, it is examined to determine the chemical constituents.

#### OPERATION

*Pelviolithotomy* There is a marked tendency toward conservatism in renal surgery. Pelviolithotomy is the procedure of choice in the removal of calculi from the renal pelvis or of small stones from the calyces which are not

TABLE I—BEFORE OPERATION

Catheterized ureters			
Microscopic Examination			
	Left	Right	
Turbidity	+	o	
Gross blood	++	+	
Red blood cells	++	++	
Pus	+++	o	
Epithelium	o	o	
Casts	o	o	
Crystals—triple phosphate	+	o	
Hydrogen-ion concentration	7.2	5.6	
Other organisms—cocci		o	

Pre-operative investigation of hydrogen-ion concentration of urine from each kidney in a patient with left renal calculus (calcium magnesium phosphate). Note difference in hydrogen-ion concentration of urine from the left kidney containing the calculi (7.2), the normal right kidney (5.6), and the bladder (6.1).

associated with a narrowing or stricture of the infundibulum. Stones which apparently are too large to be removed from the pelvis by pelviolithotomy without considerable trauma at times may easily be removed by the method described by Zuckerkandl in 1908 for inferior pelviolithotomy or by pyélotomie élargie which Marion described.

In more than 80 per cent of the conservative operations for the removal of renal calculi, pelviolithotomy has been the procedure of choice in our cases. The incision in the pelvis should be sutured with No. 00 plain catgut, care being taken that the suture passes through only the serosal layer of the pelvis and not through the mucosa into the kidney pelvis itself. In this way the suture cannot act as a foreign body and form a nucleus for the formation of a recurrent calculus. There is no doubt but that the simplicity of this surgical operation with its assurance of a minimum of trauma accounts for the lower incidence of recurrent formation of calculi following this operation.

*Nephrolithotomy* is employed in cases in which the calculus cannot be removed without trauma by the simpler method of pelviolithotomy. When a calculus is confined to the calyx and when the infundibulum is too narrow to permit its extraction through the pelvis with a stone extractor, a localized nephrolithotomy may be performed. Frequently, the small stone which is retained in a calyx may obstruct its outlet and considerable dilatation of the calyx may occur with a thinning out of

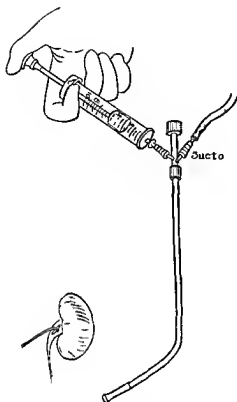


Fig 4 S i pp t s U d f r i n g l g c l y  
f l i d y d f m g s m a l l t n e s

the renal parenchyma over the calyx. Then a small incision over the dilated calyx suffices for removal of the stone. In the presence of marked infection and stasis in such a dilated calyx a heminephrectomy may be employed with excellent end results.

In the presence of larger staghorn stones a more extensive nephrolithotomy may be necessary. The bleeding can easily be controlled by compression of the vessels of the pedicle. In such cases a tube should be left in to facilitate drainage and for treatment in cases of infection. However nephrolithotomy should always be performed as conservatively as possible.

*Nephropel solithotomy* may be employed in some cases in which technical difficulties arise; however in the majority of cases calculi can be removed by *pelviolithotomy* or *nephrolithotomy*.

**Nephrectomy** In certain cases of course conservative treatment cannot be employed. In the presence of marked infection (calculous pyonephrosis) considerable impairment of renal function or cases in which the calculi are associated with coexisting pathology such as renal tuberculosis or tumor nephrectomy is necessary.

Following the removal of a calculus from the kidney the suction apparatus which was devised by Dr. Lower is used in all cases (Fig. 4). The rubber tipped tube is passed into the kidney pelvis and then into each of the calyces. By means of a two way valve the calyx may be irrigated with saline solution and suction then is applied. Frequently we have found small fragments of stone and sand adherent to the rubber tip which easily might have been overlooked if this instrument had not been used. We have found it to be of inestimable value in thoroughly cleansing the calyces and kidney pelvis following the extraction of a stone.

#### POSTOPERATIVE MANAGEMENT

A roentgenogram is secured after operation in all cases before the patient is discharged from the hospital. If a faint shadow is seen in one of the calyces lavage of the kidney pelvis with a 1 per cent solution of phosphoric acid is employed as Randall has advised. Regardless of whether a shadow may be demonstrated I usually lavage the renal pelvis in this manner at the time of postoperative cystoscopy or when ureteral dilatation is performed if it is deemed advisable for the particular case.

#### ELIMINATION OF STASIS

Uroastasis seems definitely to be associated with recurrent formation of calculi. Hunner (14) has demonstrated this relationship and well illustrated the excellent results that may be secured by its elimination. When small stones have been passed spontaneously or when cystoscopic manipulation has facilitated their expulsion trauma may have produced a stricture with resultant stasis of the upper urinary tract. Dilatation of the ureter should be employed following operation to overcome such a condition.

## ERADICATION OF INFECTION

The infections which are associated with the recurrent formation of calculi may be classified in the following two groups:

1. Infection confined to the genito-urinary tract

2. More distant foci of infection are found in the teeth, tonsils, cervix, prostate and colon

In view of the excellent observations and experimental work of Roscnow and Meisser, foci of infection should be eliminated routinely following operation. Of prime importance is the eradication of infection in the kidneys. A careful determination of the organism which is producing the infection is essential. In the absence of stasis or when a mild renal infection is present, ammonium chloride and methenamine usually will suffice, however, there should be no hesitancy in resorting to the ketogenic diet if these measures fail.

In the presence of the colon bacillus infection or of staphylococci, good results usually may be secured by urinary antiseptics or the ketogenic diet. In my experience the proteus infection is extremely difficult to eradicate. During the past 6 months I have seen 9 cases of recurrent bilateral nephrolithiasis with bilateral proteus infection. All these patients had been treated excellently elsewhere by ketogenic management without any benefit, in fact, the hydrogen-ion concentration of the urine could not be changed to the acid side. Similar results occurred under my care, however, after the high vitamin A acid-ash diet was followed for from 3 to 4 months, the infection was eradicated in 4 of the 9 cases. In the 5 remaining cases, the proteus infection still is present.

## CORRECTION OF VITAMIN A DEFICIENCY

As stated previously, the Jean's test recently has revealed the presence of vitamin A deficiency in 11 of 16 patients who had renal calculi. Due to its specific effect on epithelial structures, vitamin A should be prescribed routinely and if a deficiency is present this should never be neglected after operation. We usually prescribe one carotene in oil capsule three times daily for a period of 1 month and

then 1 capsule each morning. At the end of 1 month or 6 weeks, a Jean's test is made again to determine whether adequate amounts of vitamin A are being secured. Likewise in cases of oxaluria, vitamins B and D should be added to the diet since Neville has demonstrated the relationship between oxaluria and a deficiency in vitamins B and D.

## CORRECTION OF METABOLIC DISORDERS

As stated previously, if the calculi are due to hyperparathyroidism, this condition must be corrected. If a parathyroid tumor is present, it must be removed or recurrent calculi certainly will develop. Likewise other metabolic disorders in which cystinuria, oxaluria, or the presence of uric acid crystals and urates are found in the urine must be corrected to avoid recurrent lithiasis.

## DIETARY MANAGEMENT

Experimental evidence led us to believe that the recurrence of calculi could be minimized by adherence to a properly planned dietary regimen and the addition of vitamin A in cases in which surgery had been employed and we have followed this plan in the past 4 years. Although in many instances, the hydrogen-ion concentration of the urine serves as an index for the planning of accurate dietary treatment, if the patient has been receiving acid or alkaline urinary antiseptics, the hydrogen-ion concentration of the urine will be altered. A careful determination of the chemical constituents of the calculus and the type of crystals and sediment present in the urine is of additional value. As I stated previously, the exact hydrogen-ion concentration of the urine from the kidney which harbored the calculus must be determined in order that a correct dietary regimen may be instituted.

In cases in which the calculus is composed of calcium and magnesium phosphates, carbonate or oxalates, the high vitamin A acid-ash diet is employed routinely. Calculi composed of the calcium, magnesium phosphate, and carbonate form in alkaline urine, and calcium oxalate may be precipitated in quite a wide range of urinary reactions. In these cases the acid-ash diet shifts the reaction of the urine strongly to the acid side. The basic

TABLE II—AFTER OPERATION AND DIETARY MANAGEMENT

	Catheterized urine Microscopic Examination	
	Left	Right
Turbidity	o	o
Gross blood	+	+
Red blood cells	++	+
Pus	++	o
Epithelium	o	o
Casts	o	o
Cryst ls—uric acid	+	+
Hydrogen ion concentration	4.4	4.6
Other organisms		

After postoperative dietary management the hydrogen ion concentration of the specimen (as in Table I) was shifted strongly to the acid side (4.4 and 4.6) as indicated by the presence of uric acid crystals.

diet has an excess acid ash of 17.3 cubic centimeters which is varied daily according to the hydrogen ion concentration of the urine. As a general rule an excess acid ash of from 20 to 30 cubic centimeters is necessary to maintain the hydrogen ion concentration of the urine at a point from 5 to 5.2. In some instances additional oral medication is required to maintain this level. We have found that 7.5 grains of ammonium chloride in enteric coated pills is the most efficacious drug for this purpose and causes less gastrointestinal symptoms than other acidifying agents. As a diabetic diet must be varied or as the amount of insulin to be administered is determined by the blood sugar studies on the diabetic patient so is the excess acid ash in the diet or the medication by mouth accurately determined by the hydrogen ion concentration of the urine in patients on this routine.

Likewise when a calculus is formed in alkaline urine and when the postoperative reaction is shifted to the acid side careful check of the urine for uric acid and oxalate crystals or urates is necessary to prevent the recurrence of calculi. This can easily be accomplished by altering the diet so that the hydrogen ion concentration of the urine is changed to the point at which urates and uric acid and oxalate crystals do not appear in the urine (Tables II and III).

While in the hospital the patient is taught to make his own hydrogen ion concentration determinations of the urine with an instrument which is simple, accurate and reason-

TABLE III—AFTER FURTHER ADJUSTMENT OF DIET

	Catheterized urine Microscopic Examination	
	Left	Right
Turbidity		o
Gross blood	+	+
Red blood cells	++	++
Pus	++	
Epithelium		
Casts		o
Crystals	o	o
Hydrogen ion concentration	5	5.2
Other organisms		

By further adjustment of the diet, the hydrogen ion concentration of the urine was maintained at satisfactory level in this patient (5). Note absence of crystals.

able in price. These determinations are checked with those from our laboratory to insure the accuracy of the technique of the patient. The hydrogen ion concentration determinations are made half an hour before lunch to avoid the effects of the alkaline tide or of awakening respiration changes.

When the patient leaves the hospital he is instructed to present his hydrogen ion determination reports regularly to his family physician who then can maintain the hydrogen ion concentration of the urine at the desired level by further adjustment of the diet or by altering the medication. An occasional recheck of the hydrogen ion concentration of the urine from the kidney which originally harbored the calculus also is advisable.

In our experience recurrent calculi most frequently are composed of calcium and magnesium phosphates and many also contain carbonates. Such calculi develop in an alkaline urine and their recurrence can be minimized by the use of the high vitamin A acid ash diet which shifts the reaction of the urine strongly to the acid side. Other therapeutic procedures which have been used in the past are employed also.

Less frequently do we see cases in which the calculi are composed of cystine or urates and which are formed in acid urine. In such cases the high vitamin A alkaline ash diet is used the basic diet of which has an excess alkaline ash of 17.3 cubic centimeters. This diet is varied daily until the hydrogen ion concentration of the urine is shifted to the alkaline side.

Immediately following the operative removal of a calculus which has formed in acid urine, the hydrogen-ion concentration should not be shifted so strongly to the alkaline side that phosphaturia is present or crystals of the various phosphates occur in the urine as recurrent phosphatic calculi may develop. I prefer to maintain the hydrogen-ion concentration slightly on the alkaline side of neutral for a period of 1 month, testing the urine frequently for phosphates and carbonates and examining the urine for crystals. After this period when the vitamin A deficiency has been corrected, the incision in the pelvis of the kidney has healed well and the lesions in the pelvic mucosa have healed by vitamin A therapy, more intense alkalinization may be employed to prevent the formation of a recurrent calculus which has the same chemical constituents as the original stone. As a general rule, a hydrogen-ion concentration of 7.0 to 7.1 is satisfactory if the stone is composed of uric acid but more intense alkalinization may be necessary in cases of cystine calculi. In cases of uric acid calculi, the purines in the diet are restricted also.

While the patient is in the hospital, the dietitian instructs him daily concerning the diet, explaining why certain foods are allowed and others restricted. *The mere listing and prescribing of acid or alkaline ash foods does not suffice—a careful, scientific approach is necessary to determine the percentage of acid or alkaline ash in the diet which is required to maintain the proper hydrogen-ion concentration level in each individual case.*

By careful control of the hydrogen-ion concentration of the urine in addition to the other usual therapeutic procedures, we believe the incidence of recurrent calculi can be reduced to a minimum. However, the closest co-operation between the patient and physician is required.

#### END-RESULTS

Since we have prescribed the use of a regulated diet high in vitamin A following the operative removal of renal calculi, in addition to the other therapeutic measures usually employed, we have reduced the incidence of recurrences during the past 4 years from 16.4 per cent to 4.7 per cent in our cases. Opera-

tion has been performed for recurrent calculi in this series in 2 cases. However, 1 case was a false recurrence and in the second, the patient did not adhere to the regimen prescribed for him. We also have a series of 31 cases in which small calculi were passed at frequent intervals, and all of these patients have been free from symptoms more than 2 years.

In many cases, we have noted an eradication of the infection after the patient has been on the high vitamin A acid or alkaline ash diet for a period of from 2 to 3 months. This is probably due to the maintenance of the hydrogen-ion concentration of the urine at a point unsuitable for growth of the causative organisms.

#### CONCLUSIONS

1. Recurrent calculus formation occurs with sufficient frequency to be a serious complicating factor in the surgery of nephrolithiasis.

2. Empirical treatment which has been employed in the past does not reduce the percentage of recurrence below 10 or 15 per cent.

3. The high vitamin A alkaline or acid ash diet should be prescribed following operation, the constituents of which depend upon the hydrogen-ion concentration of the urine and the chemical constituents of the calculus.

4. A group of 31 patients who previously experienced frequent attacks of renal colic at frequent intervals and expelled small stones spontaneously, have been free from symptoms more than 2 years by dietary management.

5. During the past 4 years, since this diet has been used in conjunction with other therapeutic agents, recurrence has occurred in 4.7 per cent of the cases. This percentage, which is higher than was anticipated, is believed to be due to the fact that all patients were not given roentgen examinations routinely after operation, thus, some of the recurrences may have been false in type.

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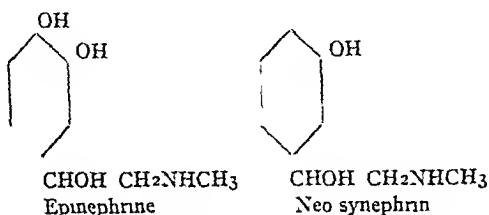


# A STUDY OF NEO-SYNEPHRIN HYDROCHLORIDE IN THE TREATMENT OF ACUTE SHOCK FROM TRAUMA OR HEMORRHAGE

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NEO-SYNEPHRIN hydrochloride is a synthetic drug very closely related to epinephrine and has the following structural formula



Neo-synephrin hydrochloride is used extensively in medicine as a vasoconstrictor but it also has pronounced systemic effects as pointed out by Kuschinsky and Oberdisse in Germany and by Tainter and Stockton in this country. According to these authors the increased blood pressure following the drug is due to a peripheral vasoconstriction and an increased cardiac output. This has been confirmed by the author for the subcutaneous injection of the drug<sup>1</sup> and Figures 1 and 2 illustrate the results of typical experiments on dogs. The drug may be repeatedly administered without an appreciable decrease in its hemodynamic effects occurring. This is illustrated in Figure 3 which represents the results of a typical experiment. The increased blood pressure following the intravenous injection of a therapeutic dose lasts about 15 minutes that following a subcutaneous or intramuscular injection from 1 to 2 hours (Fig. 4).

One of the striking differences between neo-synephrin hydrochloride and either epinephrine or ephedrin is that neo-synephrin hydrochloride slows the heart rate and has no tendency to produce irregular rhythms while epinephrine and ephedrin both increase the heart rate and have a tendency to produce irregular rhythms. In addition knee jerk experiments

of the dog by the method of Johnson (2) did not show any stimulation of the spinal cord from ordinary doses, and patients receiving therapeutic doses did not show nervous symptoms as many do with epinephrine or ephedrin.

The drug was given to a number of patients with cardiac disease and the characteristic elevation of blood pressure and the slowing of the heart occurred in all but one (Table I). This patient had frequent attacks of paroxysmal tachycardia and occasional attacks of ventricular tachycardia and was made worse by the drug. Electrocardiograms were taken during the course of all of these experiments and showed no significant changes except the slowing of the heart rate.

In acute traumatic shock or shock from hemorrhage the striking features are the lowered blood pressure, the weak rapid, and thready pulse the marked diaphoresis and the prostration of the patient who may or may not be in coma.

There are many theories concerning the mechanism of traumatic shock, but in general it is conceded that there is a disturbance of the effective blood volume. Some think that the blood volume is actually decreased as a result of a passage of fluids of the blood into the tissue spaces while others think that the blood passes into the depots of the body as a result of vasodilatation. This subject has been reviewed recently by Frazier.

In general therapy is usually directed toward restoring the blood volume, conserving body heat, the exhibition of supportive measures, and the elevation of blood pressure by means of the various hemodynamic drugs.

The drugs most commonly used for elevation of the blood pressure are epinephrine and ephedrin, and neo-synephrin hydrochloride.

Epinephrine has certain disadvantages. When given intravenously the effect on the blood pressure is very transitory and its action on the irritability of the heart is very

<sup>1</sup>From the intravenous injection of the drug, the stroke output may be decreased during the sudden and rapid rise of blood pressure presumably as a result of the marked increased peripheral resistance.

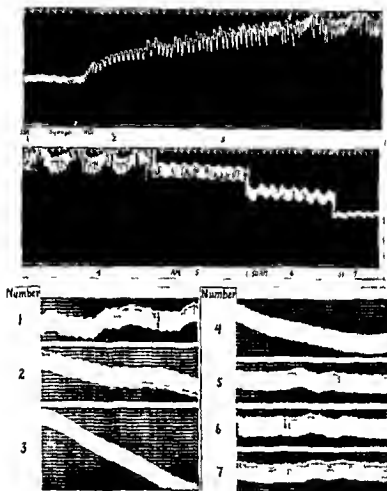


Fig. 1. The effect of Neo-synephrin on blood pressure and heart rate. The upper kymograph shows the effect of Neo-synephrin on blood pressure. The lower kymographs show the effect of Neo-synephrin on heart rate. The results are interpreted as vasoconstriction of the peripheral vessels. (The method described by Johnson, Surg. Gynec. & Obst. 1937, 55, 73.)

pronounced as evidenced by the occurrence of ectopic beats even ventricular fibrillation may result. When given subcutaneously only a slight or no elevation of blood pressure results. In addition to the effects it has on the cardiovascular system it has a tendency to make some patients very nervous and apprehensive.

Ephedrin has been used with considerable success in the treatment of shock. Johnson (3) reported a series of 10 patients in shock and in whom this drug was advantageously

employed and pointed out that its action on the central nervous system may be as important as the hemodynamic actions of the drug. However ephedrin has like epinephrine a tendency to produce ectopic beats and in certain cardiac patients may produce very unfavorable reactions.

It was thought that neo-synephrin on the basis of the pharmacological studies outlined in the first part of this paper would have the advantages of ephedrin without its disadvantages in the treatment of shock. Accord-

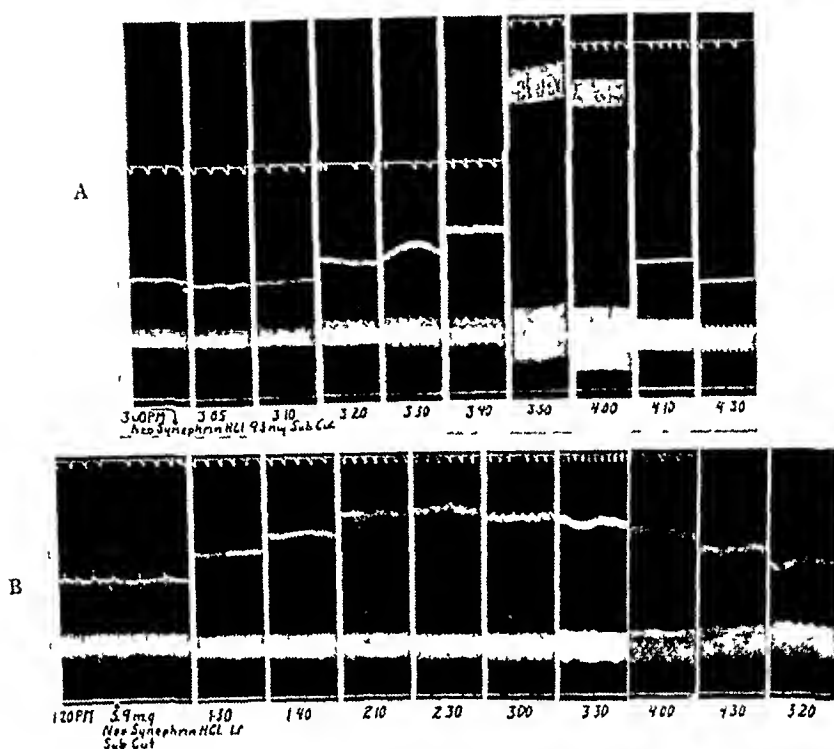


Fig 2A The chart and table shows the effects of a subcutaneous injection of neo synephrin hydrochloride in a 9.3 kilogram dog (10 milligram per kilogram) anesthetized with sodium barbital (25 gram per kilogram intraperitoneally) Note the marked increase in minute and stroke output of the heart associated with the rise in blood pressure

Time	3 00	3 05	3 10	3 20	3 30	3 40	3 50	4 00	4 10	4 30
Blood pressure	100	97	96	110	122	132	254	244	132	90
Heart rate	102	102	102	108	114	111	84	114	132	132
Stroke output*	1.4	1.8	2.0	2.2	2.8	2.8	2.4	5.4	2.8	2.4
Minute output*	1.42	1.82	2.04	2.38	3.20	3.20	40.4	60.8	28.0	25.4

\*The stroke and minute output are given in cubic centimeters

Fig 2B The graph and table shows the effects of a subcutaneous injection of neo-synephrin hydrochloride (10 milligram per kilogram) in a 5.9 kilogram dog anesthetized with sodium barbital (25 gram per kilogram intraperitoneally) The results on blood pressure, heart rate, stroke, and minute output are given The stroke and minute output did not change much in spite of the marked increase in blood pressure This suggests that in this experiment the action of the drug was chiefly on the peripheral vascular system

Time	1 20	1 30	1 40	2 10	2 30	3 00	3 30	4 00	4 30	5 20
Blood pressure	100	120	138	152	158	148	146	134	118	108
Heart rate	144	144	144	126	120	108	108	90	90	84
Stroke output*	1.8	2.0	2.0	2.2	2.0	2.2	2.6	2.8	3.0	3.2
Minute output*	260	288	288	278	240	238	280	252	270	268

\*The stroke and minute output are given in cubic centimeters

ingly it has been employed in the treatment of 6 patients in the state of traumatic shock with results best demonstrated by the presentation of case reports

#### CASE REPORTS

In the following case reports the patients received the usual treatments for traumatic shock, such as fluids, conservation of body

heat, etc These procedures are not recorded as they are more or less routinely employed in the treatment of shock Neo-synephrin hydrochloride was considered to be only an adjunct to these measures and only the data pertaining to the effect of the drug on the blood pressure and its effect on the pulse have been selected for inclusion in this report of our study

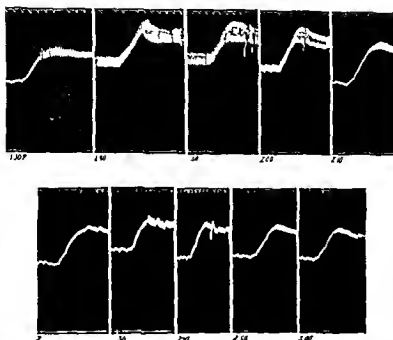
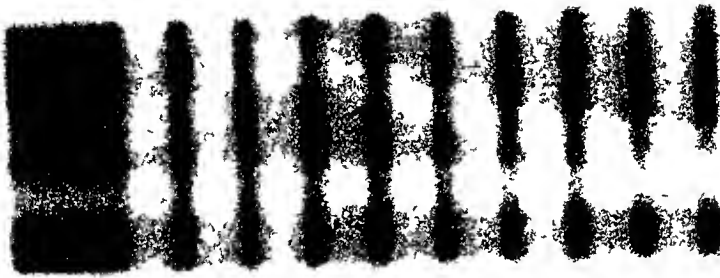


Fig. 3. The effect of repeated doses of sodium hydrochloride (54 mg) on the blood pressure of a patient with aortic stenosis. The patient had a normal ECG tracing before the administration of the drug. The blood pressure rose after the administration of the drug. The ST-segment depression disappeared after the administration of the drug.

TABLE I.—EFFECT OF SODIUM HYDROCHLORIDE GIVEN SUBCUTANEOUSLY

P	Dose	Sodium hydrochloride (mg)	Blood pressure		Heart rate	
			C	I	C	After
1.1	Thyroidectomy	500	60	60	5	55
1.2	Thyroidectomy	500	60	60	5	55
1.3	Paroxysmal tachycardia	500	60	60	60	55
1.4	Supraventricular tachycardia	500	75	60	5	60
1.5	Normal	500	75	60	5	55
1.6	Diabetes mellitus	500	44	60	7	55
1.7	Allergic asthma	500	60	60	5	60
1.8	Allergic asthma secondary to heart failure	500	75	60	5	60
1.9	Arteriosclerosis	500	75	60	5	55
1.10	Angina	500	75	60	5	55
1.11	Arrhythmia	500	75	60	5	55

The effect of sodium hydrochloride on the blood pressure of a patient with aortic stenosis. The patient had a normal ECG tracing before the administration of the drug. The blood pressure rose after the administration of the drug. The ST-segment depression disappeared after the administration of the drug.



CASE 1 L D white male aged 60 years private patient of Drs Coleman and Cuker was operated upon for a stricture of the urethra. The patient had presented urinary symptoms for some time but otherwise had been in fair health.

D t	T m	Blood pressure	Pulse	Remarks
0-35				
5-35	m	3/86		Tarsal thrust erecta with rectal catheter
	3:00 p.m.	3/86		
	7	7/7		
0-9-35	9:00 a.m.	86/60	78	
	35	76/60	78	Neo-synpharm hydrochloride—5 milligrams butaneously
		90/7	8	
	55	7/60	87	
	3	7/98	88	
	3	7/96	87	
	3	7/9	90	
	13	3/78	8	
	43	3/80	90	
	53	7/80	90	Neo-synpharm hydrochloride—5 milligrams butaneously
	10:15 p.m.	7/90	88	
	3	4/9	88	
	3	90/80	87	Neo-synpharm hydrochloride—5 milligrams butaneously
	33	4/8	86	
	43	8/8	86	
	53	7/8	8	
		5/90	8	
	3	7/8	80	
	3	7/8	87	
	33	7/8	8	
	43	7/8	8	
	3	9/80	8	Neo-synpharm hydrochloride—5 milligrams butaneously
	3	7/96	90	
	3	60/86	8	
	3	58/86	86	
		7/8	86	
	3	7/8	8	
	33	7/8	8	
	3:10	7/8	8	
	3 3	7	8	
	3 3	9/88	86	Neo-synpharm hydrochloride—5 milligrams butaneously

D	T m	Blood pressure	Pulse	Medication
	3 33	80/80	80	
	3 3	78/80	80	
	3 53	6/86	86	
	10 3	7/84	90	
	3	7/7	90	
	4 33	9/8	86	Neo-synpharm hydrochloride—5 milligrams butaneously
	4 3	8/94	86	
	53	6/86	86	
	5 3	90/80	98	
	5 33	4/7	90	
	6:00	7/7	90	
0-30-35	6:00 a.m.	7/7	4	

The patient went on to a recovery.

CASE 2 S K white female aged 46 years private patient of Dr H E Jones was admitted to St Luke's Hospital on August 9 1935 for a radical breast amputation. Eleven years previous a subtotal thyroidectomy had been performed which was followed later by a recurrence. This was treated with X-ray. Three years ago she noticed a tumor in the left breast surgery was advised but refused. This tumor has now eroded through the skin to form a fungating mass with a purulent discharge.

D	T m	Blood pressure	Pulse	Remarks
8-9-35				
8-9-35	3 3 a.m.	38/90	20	Admitted to St. Luke's Hospital
	9			Operation started
	100	7/80		Operation finished
		3/3	8	Pulse weak patient clammy Neo-synpharm hydrochloride—5 milligrams butaneously
	43	34/98		
	105	8/80		Pulse weak body warm & dry Neo-synpharm hydrochloride—5 milligram subcutaneously
		3/98		
	3	7/96	8	
	100	8/64		Neo-synpharm hydrochloride—5 milligrams butaneously
	5 p.m.	4/96		
	43	98/88	3	Neo-synpharm hydrochloride—5 milligrams butaneously
	43	8/7		
	3	80/58	44	Neo-synpharm hydrochloride—5 milligrams butaneously
		7/90		

The blood pressure was sustained and the patient went on to a recovery.

CASE 3 M C, white female, aged 42 years, was admitted to St Luke's Hospital as a private patient of Dr H E Jones, September 9, 1935, with symptoms of obstruction of the bowel. She was submitted to surgery and a large fibrous band was found to have strangulated about 3 feet of the midportion of the ileum. This portion of the bowel was resected and an end-to-end anastomosis was done between the proximal and distal portions of the ileum.

Date	Time	Blood pressure	Pulse	Remarks
9-9-35	6 40p m	83/72	140	Returned from the operating room in shock.
	7 00	90/72		
	7 30	100/70		Neo-synephrin hydrochloride—5 milligrams subcutaneously
	7 40	106/72		
	8 00	96/78	140	
	8 30	96/78	140	
	9 00	98/76	140	Neo-synephrin hydrochloride—5 milligrams subcutaneously
	9 15	106/78	132	
	10 10	110/86	132	
	10 30	110/84	134	

The patient went on to recovery

heart may be compensated for by the marked slowing of the heart rate (Fig 2 A, B). Neo-synephrin hydrochloride does not tend to produce irregular cardiac rhythms as is the case with epinephrine and ephedrin. A single subcutaneous injection usually produces a rise in blood pressure which lasts from 1 to 2 hours and this may be repeated a large number of times without much loss in hemodynamic effect and no danger to the patients. Thus allows time for the physician to institute other supportive measures, such as, restoring blood volume, conservation of body heat, etc. There is no question that some of the patients cited would have survived with the usual treatment of shock without using neo-synephrin hydrochloride, but it seems that patients in shock would have a better chance if the blood pressure is kept at a more normal level. Curiously enough, in these patients, the neo-synephrin hydrochloride did not cause the characteristic slowing of the pulse, and in general there was no significant change in the pulse.

#### SUMMARY

Neo-synephrin hydrochloride when given intravenously, intramuscularly, and subcu-

CASE 4 C B, white male, aged about 50 years, was admitted to St Luke's Hospital on October 27, 1935, as a private patient of Dr H E Jones. During a robbery the patient was shot on the lateral aspect of the right arm, the bullet coursing through the axilla, above the sternum, beneath the skin to lodge subcutaneously just lateral to the left nipple. The patient was brought to St Luke's Hospital in shock.

Date	Time	Blood pressure	Pulse	Respiration	Remarks
10-27-35	9 15a m	120/100	124	24	
	9 45	142/84	116	20	
	10 15	80/60	120	20	Shock
	10 45	80/50	104	32	
	12 45p m	100/65	120	24	
	1 30	93/70	120	24	
	2 00	88/60	118	24	
	4 00	75/50	116	24	Neo-synephrin hydrochloride—5 milligrams subcutaneously
	4 15	98/68	118	24	
	4 30	100/65	116	24	
	4 45	77/55	124	20	
	5 00	86/60	120	26	
	6 30	76/60	110	24	Neo-synephrin hydrochloride—5 milligrams subcutaneously
	8 00	98/60			
	12 00	112/70			
	10-28-35	8 50	126/83	98	22

The patient went on to recovery

taneously, causes a marked rise in blood pressure and a slowing of the heart rate. The increased blood pressure from an intravenous injection lasts about 15 minutes while from a subcutaneous injection it lasts from 1 to 2 hours. The subcutaneous dose of the drug is roughly 10 times the intravenous dose, and one must be cautioned not to inject intravenously the amount of the drug which one would inject subcutaneously. (This is as true for neo-synephrin hydrochloride as it is for epinephrine.) From the subcutaneous injection the rise in blood pressure is due to the increased stroke output of the heart and the marked increased peripheral vascular constriction (see footnote, first p). The drug may be given a large number of times without much loss in its hemodynamic effect and even in large doses does not tend to produce irregular cardiac rhythms. In addition there is no evi-

CASE 5 J L white male aged 39 years private patient of Dr Duff was admitted to St Luke's Hospital on September 13 1934 following an injury in which a steel plate struck his left leg and right arm. A compound fracture was present in the region of the left ankle.

Date	Time	Blood p	Pulse R	R marks
9-4-35	8:00 a.m.	43/7		
	10	66/7		Direct tra. hemo gon cubic mm crs
	10			Sy. knistart. te cubic ly
	3 p.m.	86/7	3	Neo-syn phrin hydrochloride mg. te easily
9-5-35	3:00	9/7		
	9:00	60/7	3	35
	9:00	24/14	34	3 Neo-syn phrin hydrochloride milligrams subcutaneous
	8:00 a.m.	7/8	5	3
9-7-35	3 p.m.	7/7	3	35
		6/8		
9-8-35		8/8		

The patient went on to a recovery and was discharged January 31 1935.

dence of spinal cord stimulation as measured by animal experiments or evidence of cerebral stimulation following therapeutic doses in man.

Reports have been presented in which neo-synphrin hydrochloride was used as an adjunct to the usual methods of treatment in 6 patients manifesting surgical and traumatic shock.

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CASE 6 A B white female aged about 45 years was admitted to St Luke's Hospital on July 27 1934 following an accident in which she was struck by a truck. There was a crushing injury to the right elbow which severed the brachial artery and the patient lost a great deal of blood before the tourniquet was applied. In addition there were lacerations and contusions about the body and head.

Date	Time	Blood p	Pulse	R marks
7-7-35	8:30 a.m.	7		
	9	7/5	4	Shock
				Neo-syn phrin hydrochloride milligrams subcutaneous
	9:40	8/60	8	
	9:50	84/56		
	9:55	86/56		
	10:00	86/60		Neo-synphrin hydrochloride milligrams subcutaneous
	10:05	90/66		
	10:10	96/60		
	10:15	86/60		Neo-syn phrin hydrochloride milligrams te v. easily
	10:40	7/7		
	11	80/5		
	11:00	8/5		
	11	5/7		
				T. infused 35 mg. in blood. bic. cr. te.
	6:00 p.m.			T. infused 35 mg. in blood. bic. cr.
	6:00 p.m.			Amput. left arm

The patient died the next day.

Although this patient died these results show that it is possible to sustain the pressure while other methods of treatment are instituted. The patient was moribund to start with.



## AN ANALYSIS OF THE MORTALITY OF GALL-BLADDER SURGERY

WITH A SPECIAL NOTE ON THE SO CALLED LIVER DEATH, BASED ON 404 CONSECUTIVE SURGICAL CASES AND 100 CONSECUTIVE SURGICAL DEATHS IN THE NEW ORLEANS CHARITY HOSPITAL<sup>1</sup>

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THE surgery of biliary disease has far-reaching implications. It may begin with the gall bladder, but it by no means ends with it. The surgeon, for instance, who operates on the gall bladder operates vicariously, as it were, on the liver, and the consequences are frequently out of all proportion to the apparent ease of the surgical act. The chain of events is quite clear. Unless biliary disease is treated very promptly, it always terminates in some degree of liver damage, if indeed, as Graham and others believe, the liver damage does not precede it. Be that as it may, the liver is always involved, and the involvement is always potentially serious. The liver has enormous powers of regeneration, but some insults it cannot endure, and such insults are often initiated by the original disease and are carried beyond the point of tolerance by the surgery instituted to relieve it.

Again, while gall-bladder disease may and does occur in early life, it is pre-eminently a disease of the middle years, the years in which cardiovascular and cardiorenal and other degenerative diseases begin to take their toll. Whether those diseases occur independently or whether, as much evidence goes to prove, they are the direct consequence of the biliary disease, is not so important in this connection as is the simple fact of their existence, which in itself increases many times the risk of surgery upon such subjects.

Finally, respiratory complications are notoriously frequent in upper abdominal surgery and are particularly likely to occur in persons of middle age and later life. It must be emphasized, too, that all of these risks are over and above the risks of hemorrhage, shock, infection, and other surgical complications which are associated with any surgical procedure, however simple.

The mortality of gall-bladder surgery is much too high. Brilliant individual surgeons

and exceptionally well organized clinics report mortality rates of 1 to 3 per cent, and we may take such results as our standard, but we must not quote them as if they were our own. The mortality of the average surgeon and the average mortality of all surgeons form a far truer index of the real situation. Such an index has recently been furnished by Heuer, who showed that in 36,623 cases collected from the literature the death rate was 6.6 per cent (2,453 cases), which, for all sorts of cases done by all sorts of surgeons, does not seem so bad. But a more careful analysis shows that the mortalities of the various series which make up the total vary from 2.6 per cent to 10.4 per cent, and such figures leave very little room for complacency on the part of those who are in the upper levels.

Our attention was attracted to the mortality of gall-bladder surgery by our search of the records of the Charity Hospital in New Orleans, in an endeavor to locate the cases of so called liver death following operations on the biliary system. As a by-product of that study, which has already been published in the *Archives of Surgery*, we are publishing herewith an analysis of 404 cases of gall-bladder disease for the 3 year period ending December 31, 1934, and an analysis of 100 consecutive fatal cases which have occurred in the last 8 years in this institution.

The 404 cases resulted in a mortality of 37 cases, 9.1 per cent, which is exceedingly high, but which, in all fairness, must be broken down into its component factors. Such an analysis reveals, in the first place, that the dictum that the more surgery a man does, the lower is his mortality, is sometimes fallacious and may need qualification. The whole series was done by 40 different surgeons, but the mortality in 242 cases done by 6 surgeons was 13.3 per cent (25 cases), whereas the mortality in the remaining 162 cases done by 34

<sup>1</sup>From the Department of Surgery of the Louisiana State University School of Medicine.

surgeons was only 7.4 per cent (12 cases). The explanation however is quite simple. The first group includes practically all the cases of empyema, rupture and gangrene, many of which were desperate risks, and the mortality in it would naturally be higher than in the second group, which was composed largely of elective cases done under more favorable circumstances.

The higher female incidence, 29.5 to 10.9 cases, and the lower female mortality, 8.1 per cent to 11.9 per cent, duplicate the experience of most surgeons, though the significance of the disparity is rarely emphasized as it should be. The importance of the sex factor in biliary disease has recently been studied by Louis F. Dublin, whose figures show that the life expectancy of males after biliary surgery is considerably less than that of females, especially when stones are present. Dublin points out also that males are particularly prone to develop malignancy of the gastrointestinal tract after operations on the gall bladder.

The marked difference in this series between the negro and white incidence and the negro and white mortality is perhaps rather startling to persons who are not aware, as we are, of similar racial disparities in other surgical states. In the 404 cases there were only 59 in the negro against 345 in the white, a proportion of roughly 1 to 6, this being quite out of proportion to the negro and white hospital admissions, which are roughly 3 to 4. Further more, the negro mortality, 8 cases, constitutes more than a fifth of the total number of deaths, and the actual rate, 13.6 per cent, is more than 5 points higher than the white rate of 8.4 per cent. Other writers, particularly Emile Bloch of New Orleans, have called attention to the infrequency of gall bladder disease in the negro, and to the still more marked infrequency of gall stones, but have offered no satisfactory explanation for it. Our own opinion is that the negro once possessed some true racial immunity to gall bladder disease, which he is slowly losing, and that the high negro mortality can be explained by the fact which can be repeatedly proved in other surgical conditions, that when once native immunity to a disease has been lost, its mani-

festations are likely to be more severe than they are in individuals who have never been immune. Another obvious explanation of the high negro mortality is the negro's habit of delaying medical consultation until pain and disability drive him into the hospital.

The mortality by ages, as Table I shows, is unduly high below 20 years of age, perhaps because at that period of life the disease is less frequent and less typical, and it shows a steady rise from the fortieth year onward. It is a striking fact which has been noted by other writers also, that more than 70 per cent of the mortality of gall bladder surgery occurs in persons over 50 years of age, although less than half of all cases occur in that age group. The distribution is not surprising for individuals beyond middle life are frequently victims of degenerative diseases which add to the risk of gall bladder surgery. In this series, as in most others, perforation and gangrene were more frequent in the upper age groups than in the lower ones.

The 100 consecutive deaths which we have studied in detail were assigned, after careful study of each case, to the following causes of death:

1. Peritonitis 24 cases
2. Liver death syndrome 23 cases
3. Pulmonary complications 17 cases
4. Shock and hemorrhage 11 cases
5. Cardiorenal complications 10 cases
6. Miscellaneous causes 15 cases

A comparison of these proportions with the proportions in the 2,453 deaths collected from the literature by Heuer, and with the 500 deaths collected by Stanton, including 100 cases he personally studied, is not very easy, because of the difference in approach. In the first place, as Stanton points out, the cause of death is always merely a clinical opinion unless autopsy is done, and even autopsy does not always settle the question, though it happened to settle it in the 29 postmortem examinations done in our personal fatal series. Again, both Heuer and Stanton list as the cause of death in certain groups the pathological process originally responsible. Heuer charges 11 per cent of his fatal series to gangrene and perforation, and Stanton charges 50 per cent of his to inherent pathology.

TABLE I—MORTALITY BY AGE GROUPS IN 404 CASES, AND DISTRIBUTION BY AGE GROUPS IN 100 CONSECUTIVE DEATHS

	Total cases	Deaths	Rate	100 deaths Percentage
Under 20 years	7	1	14.2	2
Under 30 years	77	3	3.9	11
Under 40 years	124	6	4.8	17
Under 50 years	105	6	5.7	24
Under 60 years	57	8	14.0	25
Under 70 years	23	8	34.8	13
Over 70 years	11	2	45.4	8
Limits	9 to 78 yrs			10 to 78 yrs

On the other hand, we have classified all of our cases strictly according to the immediate cause of death. Heuer classifies peritonitis, shock, and hemorrhage together, the combined figures amounting to 33 per cent. Stanton classifies them separately as we do, considering peritonitis, the responsible factor for 21.8 per cent of all deaths, and shock and hemorrhage the responsible factors for 15.4 per cent.

The most notable feature in our series is the high percentage of so called liver deaths, 23 per cent, as compared with the 4 per cent reported by both Heuer and Stanton in their collected series. It is very interesting to note, however, that this type of death constitutes 15 per cent of the 100 cases studied by Stanton personally. In our 100 fatal cases 40 per cent of the patients were rated as good risks, 20 per cent as fair, and 39 per cent as poor, 1 was moribund. It is an arresting fact that the group of liver deaths contained the highest proportion of good and fair risks found in any of the groups.

The mortality in relation to pathology in the 3 year series, and the proportionate distribution in the 100 fatal cases, are set forth in Table II, and the figures speak for themselves. One fact should be stressed—that in 4 of the 100 fatal cases the duct stones were discovered only at autopsy, which suggests that they existed in a similar proportion of patients not submitted to postmortem study. Such an error is not to be condoned, but it does not seem in any case in this series to have been responsible for the fatality, though had

TABLE II—MORTALITY ACCORDING TO PATHOLOGY IN 404 CASES, AND DISTRIBUTION BY PATHOLOGY IN 100 CONSECUTIVE DEATHS

	Total cases	Deaths	Rate	100 deaths Percentage
Acute	35	10	28.6	9
Subacute	36	2	5.5	2
Chronic	294	16	5.4	58
Empyema	26	4	15.3	12
Rupture	5	3	60.0	9
Gangrene	6	0	00.0	5
Hydrops	2	2	100.0	2
Stones (all)	157	16	10.1	42
Duct stones	13	3	23.0	7
Jaundice	68	10	14.7	35
Without jaundice	336	27	8.0	65
Peritonitis	7	2	28.5	4

the patient lived it would most likely have caused further trouble. Lahey's figures in this connection are very striking. In recent years the incidence of exploration for duct stones has been doubled in his clinic, the result being that the incidence of stones found has also doubled, while the mortality has shown a very marked decrease.

The mortality according to procedure (Table III) reveals nothing that one does not already know. It is not surprising that the mortality of cholecystostomy should be higher than for cholecystectomy, and that the mortality for choledochostomy should be in turn, higher than for cholecystostomy. During recent years, in the practice of most surgeons, cholecystostomy was reserved for those cases in which the condition of the patient, the extent of the disease, or the desire to preserve the gall bladder for possible future surgery, contra-indicated its removal. Gelpi's figures from the New Orleans Charity Hospital for 476 cases done between 1914 and 1925 prove this point quite clearly. In that series, when cholecystectomy and cholecystostomy were used almost interchangeably, the mortality for the two procedures was practically identical. With the recent renewal of the debate as to whether cholecystostomy is not the safer procedure, it may be that the figures for the next few years will reverse those we are now reporting.

TABLE III—MORTALITY ACCORDING TO PROCEDURE IN 404 CASES AND DISTRIBUTION ACCORDING TO PROCEDURE IN 100 CONSECUTIVE DEATHS

	T I ases	D ths	Rat	D ths P re tag
Cholecystomy	31		6	55
Cholecystostomy	5	9	8	3
Cholecystomy		6	3	
Other procedures	3		66.6	
D & G	66		5.6	7
Appendectomy		8	6	9

Duhlin in the study referred to notes that the late death rate after removal of the gall bladder is only 95.9 per cent of the expected rate whereas after drainage it is 153.7 per cent and after drainage for stones it is 214.9 per cent. The mortality by sexes after drainage is equally striking being 233.3 of the expected rate for men but only 65.6 per cent for women. These figures lend further significance to the fact that in the 100 fatal cases which we have studied 8 patients had previously been submitted to cholecystostomy as had 18 patients 1 of whom died in the 3 year series.

In this community drainage is very frequently not done after cholecystectomy for uncomplicated disease unless some special indication exists and it is not surprising therefore to find the mortality for drained cases in this study materially higher than for the cases not drained. Nor is it surprising to find in the 100 fatal cases that in only 30 was cholecystectomy done without adjunct procedures or to find that drainage was done in 47 cases. In the 129 cases in the 3 year series in which appendectomy was done in addition to the gall bladder operation the mortality was almost 3 per cent lower than the mortality for the whole series (6.2 per cent against 9.1 per cent) and appendectomy was done in only 19 of the 100 fatal cases. Clearly this procedure is reserved for those patients whose condition is assumed to be good enough to warrant the slight added risk entailed in removing a structure whose continued presence holds potentialities of trouble from the cradle literally to the grave.

The anesthetic factor is usually of no particular importance from the standpoint of mortality. On certain services unless contra indications exist spinal analgesia is routine just as on certain others general anesthesia is routine and in the 3 year series the mortality is almost the same 8.3 per cent for spinal against 8.5 per cent for ether. In the fatal cases ether was used in 35 and spinal in 48 which may be of some significance for an unwisely administered spinal anesthetic is possibly more dangerous than an unwisely administered ether anesthetic. The mortality for local analgesia 50 per cent in 4 cases and for ethylene anesthesia 12.5 per cent for 16 cases is no reflection on either variety of anesthesia in this hospital the mere fact that these agents were employed means that the patients were considered doubtful risks.

In all studies of gall bladder surgery the vexed question of the immediate versus the deferred operation demands consideration and as was pointed out in the symposium on the subject held by the American Surgical Association in 1933 there is excellent authority for either point of view especially when such men as J. M. T. Finney Sr. and Dean Lewis are on opposite sides of the debate. Harvey Stone's argument is naturally beyond refutation that there may be some gifted diagnosticians who can tell when an acute process will subside and when it will go on to perforation and gangrene but he is not among them and he has no regrets about it either. Equally beyond contradiction is his further argument that whether or not a surgeon possesses the skill necessary to handle a difficult acute case has nothing to do with the matter since it is not a sound policy to compromise principles of treatment to suit an assumed deficiency of skill in the profession.

But other things must also be considered. There is a rather frequent tendency among the advocates of the immediate operation to argue in generalities and to charge all cases of empyema perforation gangrene and peritonitis against the conservative type of treatment. This is far from the truth at least if the Charity Hospital figures are representative as we believe they are. Of the 26 cases of empyema gangrene and rupture in the 100

deaths which we studied, only 5 were in patients in whom operation had been delayed in the hospital, in the other 21 the blame must be put upon the patients who delayed seeking medical treatment until they had reached this state, for in them all operation was done as an emergency measure as soon as they were admitted.

It would be well, it seems to us, if all the statistics of biliary surgery were made up so that uncomplicated and complicated acute cases could be discussed separately. It is hardly fair to discuss complications which existed before the surgeon saw the patient as if they were his responsibility and had occurred under his eye. It stands to reason that the competent and intelligent surgeon will not continue to employ expectant treatment beyond a certain time if he sees that it is not successful. On the other hand, a very strong argument in favor of immediate operation is the fact that serious complications are not always recognized beforehand. In one of the delayed cases in our series, for instance, rupture was not suspected until operation was done, and in 7 cases in the series reported by Judd and Phillips it was not suspected until autopsy. Be that as it may, the mortality for operation in the acute stage in this series, as in most reported series, is still considerably higher than the mortality for the interval operation, and in our opinion the last word is still to be said on the subject.

Pulmonary complications are exceedingly disturbing, for they follow all types of anesthesia here as elsewhere. In the 17 cases included in our series of fatalities, the anesthetic agent was spinal in 7 cases and local in 2 which would seem to lift from ether anesthesia much of the onus which it has had to bear in this connection. Indeed, there is no longer any doubt that the responsibility for such complications must be charged against surgical procedures in the upper abdomen rather than against the anesthesia used in their performance. After such operations the vital capacity is reduced, the chest expansion is limited, and more or less atelectasis is almost always present. We personally agree with Stanton that the high incidence of pulmonary embolism which he found in his collected series, and

which is at variance with his personal experience, suggests that the authors reporting the cases were perhaps rather partial to that diagnosis. Embolism does not appear as a cause of death in our own fatal series, and we have been impressed, in a study now in progress of the surgical autopsy material in Charity Hospital, with the actual rarity of this complication, particularly as compared with the tendency of most internes—and of all too many practicing surgeons—to explain all cases of sudden death by it.

The high incidence of cardiorenal complications in biliary disease is to be explained partly by the age at which this disease occurs most frequently, and partly as a cause and effect relationship, for which strong proof is furnished by the improvement so often apparent in the cardiac condition after the biliary infection is eliminated. Whether or not this be true, it is easy to see how the sudden development of a serious infectious process may throw upon an already damaged heart a burden which it can scarcely bear, and how the added strain of surgery may be the straw that turns the tide. Such damage, too, is likely to be irreparable, as Judd and Priestley have shown in an analysis of 65 late deaths after gall-bladder surgery, in which cardiac disease and apoplexy were responsible for 45 per cent, whereas normally they would be responsible for not more than 20 per cent.

The incidence of hemorrhage as a cause of death in jaundiced patients is surprisingly small in this hospital. Seven of the 11 patients in the shock and hemorrhage group died of shock, of that there is no possible doubt. Of the 4 remaining, the first patient perhaps died of shock but more probably as the result of the spinal anesthetic, he collapsed at the end of the operation and died on the table. The second patient lost a moderate amount of blood on the table, when an anomalous artery was cut, considerable trauma being inflicted before the bleeding was controlled, she died 10 hours after operation, perhaps of hemorrhage, more probably of shock. The third patient took a sudden turn for the worse 18 hours after operation, and died 3 hours later, the clinical signs pointed to deferred shock, but as autopsy was not permitted it may be

that hemorrhage was present. The fourth patient a badly jaundiced negro male who was still regarded as a very poor risk after scrupulous pre-operative preparation did not lose an undue amount of blood at operation and left the table in fairly good condition. An hour after his return to the ward he fell out of bed and he died 2 hours later. At autopsy the exact origin of the blood in the abdomen could not be determined and it may be that death was due to trauma rather than to continued oozing. Even if the last 3 fatalities are charged against hemorrhage the percentage of such cases is still very small and is in decided contrast to Walters' generally accepted dictum that 50 per cent of all patients with jaundice die of hemorrhage. It is likewise in contrast to Stanton's figures which show that in 42 deaths due to cholemia hemorrhage was a feature in 20 or almost half.

Miscellaneous causes of death in this series include such conditions as mesenteric thrombosis associated with pancreatic necrosis shock following the resuture of a partially eviscerated wound deprivation of bile as the result of biliary fistula in one case associated with hypoglycemia renal failure not to be confused with the type of renal failure seen in the liver death syndrome acute gastric dilatation cerebral hemorrhage intestinal obstruction subphrenic abscess which was drained 2 days antemortem staphylococcal septicemia cirrhosis of the liver. In 1 case no cause of death could be determined clinically and autopsy was not permitted. Stanton believes that cholangitis or liver abscess is frequently overlooked as a cause of death and he thinks also that subphrenic abscess which is rarely recognized clinically is rather more frequent than is suspected. How many cases of the latter condition are overlooked at Charity Hospital we have no way of knowing but as far as proof by operation or autopsy is concerned it is our impression based on a careful study of many records that it is suspected in this institution decidedly more frequently than it is proved.

We have purposely reserved until the last the group of 23 so called liver deaths which form a unique feature of this special study and which constitute a higher percentage of

such deaths than is noted in most other studies. This group of cases has recently been studied exhaustively in two previous publications (Boyce and McFetridge) and the following summary is taken from those papers in the first of which 20 cases are analyzed and in the second of which the number is raised to 23.

It should be emphasized in the beginning that these cases were selected with the utmost care. In the 100 fatalities studied there were several other cases in which a similar cause of death might reasonably have been presumed—a point which Stanton also makes in his discussion of 15 such cases in his own series—but because some other factor was present which might confuse the situation we omitted all of them from the analysis.

Group 1A consists of 8 cases in which death occurred within 40 hours after operation with hyperpyrexia as the only notable symptom. The patients whose ages ranged from 36 to 58 years all gave a history of long standing biliary disease. Three of them were very obese and 3 had calculous gall bladders but only 1 was jaundiced and all of them were regarded as good or fairly good risks. Ether anesthesia was used in 6 cases and spinal analgesia in 2 and the surgical procedures were evenly divided between cholecystectomy and cholecystostomy. All had some sort of pre-operative preparation. One patient exhibited an old rupture, empyema and a small patch of gangrene but in no instance was the pathological process such as to make one anticipate a fatal result. The terminal (axillary) temperatures ranged from 105.2 to 107 degrees F and in the 1 case in which postmortem was done the only positive finding was degenerative changes in the liver associated with some congestion of the kidneys.

Group 1B consists of 5 cases in which death occurred within 72 hours after operation again with hyperpyrexia as the only notable symptom. The patients whose ages ranged from 24 to 58 years all had a history of chronic biliary infection of many years duration. In addition 1 patient was jaundiced 1 had had a previous cholecystostomy and 2 were obese although 2 others had lost con-

siderable weight. All were regarded as good or reasonably good surgical risks. One operation was done as an emergency immediately after admission, in all the other cases the preoperative preparation was more or less adequate. Ether was used in 2 cases, spinal analgesia in 2, and spinal and ether in the other. Cholecystectomy was done in 4 cases and cholecystostomy in the fifth. In 4 cases the gall bladder was calculous and in the fifth it was hydropic. In all instances the clinical course was the same, a fairly satisfactory recovery for 24 or 48 hours, followed by hyperpyrexia (105 to 107 degrees F by axilla) and a rising pulse rate. The carbon dioxide combining power of the blood ranged from 24 to 38 volumes per cent. Autopsy was not permitted in any case.

Group 1C consists of 2 cases in which death occurred within 6 days after operation, the hyperpyrexia developing 24 to 48 hours antemortem, after a fairly smooth convalescence. The patients, who were 23 and 48 years old, respectively, were both good risks although 1 was jaundiced and 1 had a gall bladder full of stones. Ether anesthesia was used in 1 case, and ethylene and ether in the other and cholecystectomy was done in both. In both cases there was a pronounced terminal oliguria. In 1 case the previously normal non-protein nitrogen content of the blood rose to 50 milligrams per 100 cubic centimeters, and in the other the carbon dioxide combining power of the blood was 48 volumes per cent. In both cases only partial autopsy was permitted, and the kidneys, unfortunately, were not examined, but there was no evidence whatsoever of peritonitis, and the liver showed the type of necrosis evident at autopsy in the cases in group 1A.

Group 2A consists of 5 cases in which a smooth convalescence of several days was followed by oliguria, progressing to anuria, and death in uremic coma. The patients, who ranged in age from 32 to 49 years, gave the usual history of biliary infection, 2 were jaundiced, 2 had stones, 1 had empyema, 1 hydrops, and 1 a patchy gangrene. Ether was used in 1 case, ethylene and local infiltration in 2, and spinal analgesia in 2. Cholecystectomy was done in 2 cases, cholecystostomy in

2, and choledochostomy in 1. In all cases there was a postoperative rise in the non-protein nitrogen of the blood, in 1 instance to 240 milligrams per 100 cubic centimeters, and the urine showed albumin and casts not previously present. In 2 cases, as in the similar cases reported by Helwig and Schutz, the wound ruptured. In the 2 cases in which autopsy was performed there was found, in addition to the necrotic degeneration of the liver noted in the group 1 cases, a similar type of degeneration in the convoluted tubules of the kidneys.

Group 2B consists of 3 cases in which a pronounced cardiovascular collapse occurred from 60 to 92 hours after operation, with clear evidence of vasodepression, and in 1 case repeated convulsions. Oliguria was pronounced in the 2 patients who lived longest, and none lived more than 6 days after the collapse. The age range in this group was from 24 to 52 years, all the patients gave the usual history of long standing biliary disease, and although one was obese, all were regarded as good or fairly good risks. In 1 case the gall bladder was filled with stones, and operation was technically very difficult. Ether, spinal and splanchnic anesthesia were employed, and cholecystectomy was done in all cases. After operation the non-protein nitrogen content of the blood was 74 milligrams per 100 cubic centimeters in 1 case and in another 120 milligrams. Postmortem examination was not permitted in any case, but in none was there any clinical evidence of peritonitis or pneumonia.

Clinically and histologically these cases fall into two distinct groups but beyond that no common factor is apparent. The age range is from young adult life to old age. Some of the patients were obese, but well over half of them were not, and some had lost weight. All varieties of anesthesia were employed, and in only a few instances was the pathological process such that a stormy convalescence could have been anticipated. Operation, in most cases, was fairly easy, and the great majority of the patients were regarded as good or fairly good operative risks.

The literature of liver deaths has been thoroughly reviewed in our first publication on this subject. Charles Gordon Heyd, who

originally called attention to this syndrome has been followed by numerous other writers most of whom report only isolated cases or very small series of cases. Connell's list Stanton's and our own are the largest on record. It is interesting to note however how much more frequently this type of death is being reported or more correctly is being recognized and for our own part since we have become interested in the syndrome we have developed the perhaps questionable habit of interpreting in the light of our own experience many reported cases in which the cause of death is listed as undetermined.

The various theories advanced to explain so called liver deaths are set forth at length in our first communication on the subject. The theory which we ourselves (Boyce and McFetridge) have advanced is based on a study of the 23 cases just outlined plus a long series of experiments likewise reported in detail in our first communication. It is briefly this:

The patient with biliary disease whether or not gross obstruction is present always exhibits some degree of liver damage which is not however incompatible with the stress and strain of ordinary life. But when surgery is undertaken even under the most favorable circumstances there are introduced other factors including the anesthetic the trauma of the surgical manipulation the associated drop in intraabdominal temperature and changes in intrahepatic and biliary pressure and with these new factors the liver already the seat of a pathological process cannot cope. As a result its function promptly fails and the toxic substances which reach it in the course of normal body metabolism are thrown off undetoxified. Then the liver cells as they become increasingly unable to function themselves undergo some necrotic change and themselves discharge into the circulation some additional toxic product which originates in their own degenerating cellular substance.

The next assumption follows logically upon the first. The kidney which after the liver is the great detoxifying organ of the body must take up the work of the liver purely as a matter of physiology when the detoxifying function of the latter organ fails. But in the kid-

ney the margin of safety is very slight and it is not fitted to handle even the normal products of body metabolism let alone in addition the toxins liberated by the damaged liver cells. It promptly fails in its turn therefore and an overwhelming and lethal toxemia is the natural consequence.

We believe finally that the so called liver death or liver kidney syndrome is a single pathological process in which the hepatic changes always precede the kidney changes. In our opinion if the patients who die promptly with hyperpyrexia and who exhibit liver degeneration at autopsy could be kept alive long enough they also would show precisely the same clinical and postmortem renal changes as do the patients who die later with typical symptoms of uremia.

Of all the theories hitherto advanced to explain the cause of death in these cases that of Helwig and his associates Schutz Kuhn and Orr is nearest our own. The difference is that they postulate a specific action of the liver toxins upon the kidney cells a hypothesis which we consider unnecessary. We believe it only natural that the pathological process should center in the kidney since its convoluted tubules are the normal channels of excretion for foreign proteins which we assume these liver toxins to be. In other words the kidney is damaged simply in the fulfillment of the abnormal duty suddenly placed upon it or to speak more accurately in the fulfillment of an exaggeration of its normal duty.

We believe that by recent experimental work (Boyce and McFetridge 3) we have eliminated changes in the biliary ducts as a possible cause of death in these cases. That such a cause could be responsible we considered unlikely from the beginning since as we have shown in previous communications it is our opinion that the same syndrome is apparent in other pathological states in which the biliary ducts could not possibly play a part these including such widely divergent pathological processes as pancreatic disease trauma to the liver from gunshot wounds and other accidents toxic thyroid disease and intestinal obstruction.

Thirty-one of the patients in the 100 fatal cases had some sort of cardiac renal or car-





cases of jaundice in which hemorrhage seems likely to occur

It has long been recognized that the preparation of poor risk patients for gall bladder surgery by such measures as a diet high in carbohydrates fluids by all routes and dextrose as necessary orally and intravenously will go far to reduce the surgical mortality and recent work on the so called liver death has confirmed the importance of such preparation and has widely extended its indications. This complication when it does occur always strikes as a bolt from the blue and in the least expected cases it is almost invariably fatal and there seems no way to foretell and to guard against it. If the theory be correct that it is preceded by some degree of liver damage then the obvious precaution would be to identify that damage. As yet no infallible method is available but the best results on record are reported by Graham. Using isoiodelkon and taking a 50 per cent retention as an arbitrary standard of safety for operation without elaborate preparation he was able to reduce his mortality in simple cholecystectomy from 6 per cent to 4 per cent and his mortality in common duct surgery from 7.7 per cent to 2 per cent. Regardless of how inaccurate a test may be it is worthy of routine use if it can produce such results as these.

In the same connection Wilensky's suggestion is of real value that hepatic function be estimated in the light of renal function and that evidence of renal insufficiency in cholelithiasis and kindred diseases be regarded as presumptive evidence of hepatic insufficiency. We are impressed too with the recent reports on the use of the hippuric acid test as an index of the state of the liver and are at present preparing to employ it on all our gall bladder patients.

The crux of the whole matter it seems to us lies in Graham's statement that the patient with a damaged liver presents a questionable risk for any sort of surgery biliary or otherwise. That warning taken at its face value will mean for all practical purposes a surgical revolution as we have pointed out in our first communications on the so called liver death. There will be no more simple surgery.

From the standpoint of biliary surgery the corollary is that the surgeon who proposes it must remember that hepatic disease of some degree is an invariable concomitant of biliary tract disease of any degree and must regard all his candidates for such surgery as potentially poor risks regardless of how incongruous their inclusion in such a category may seem.

Finally since the catastrophes of biliary tract surgery whatever may be their immediate cause invariably have for their ultimate cause delay in the institution of surgical measures there seems no logical reason for prolonged medical treatment of cholecystic disease. That does not mean the performance of cholecystectomy on insufficient indications nor does it necessarily mean unless one's convictions happen to lie that way the performance of operations during acute attacks. It does seem only reasonable however not to allow a pathological process to continue with out restraint when its end results with delayed treatment can be as serious as the experience of every surgeon has proved them to be.

#### SUMMARY

1. A detailed study is made of 404 consecutive surgical cases and 100 consecutive surgical deaths from the records of the New Orleans Charity Hospital.
2. These cases are analyzed from the standpoint of age race sex pathology procedure and cause of death.
3. Particular attention is paid to 23 cases of so called liver death for which a new theory is advanced.
4. Methods by which the mortality of biliary surgery can be reduced are briefly outlined again with special attention to the liver death syndrome.

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# CLINICAL SURGERY

FROM THE SURGICAL CLINIC LENOX HILL HOSPITAL

## TREATMENT OF CARCINOMA OF THE ESOPHAGUS

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CARCINOMA of the esophagus usually comes under a surgeon's observation when it is far advanced locally and when as a result of malnutrition patients have become emaciated and dehydrated hence the treatment of this condition in most instances is limited to palliative measures. Other factors enter into this deplorable situation namely the frequent co-existence of myocarditis nephritis emphysema or arteriosclerosis which contra indicate an extensive operation. In addition to all this the lesion is difficult of access and frequently irremovable because of adhesions to important surrounding vital structures as a result of which the prognosis in operative intervention is not good. Consequently surgeons as a rule are disinclined to operate and progress in this important field is therefore limited to the few individuals or clinics willing to do pioneering surgery against great odds.

*Palliative treatment* consists of measures for the relief of symptoms and for prolongation of life. The chief symptoms are difficulty in swallowing, loss of weight and strength, pressure under the sternum, backache and pain. Loss of weight and strength are the result of esophageal obstruction and for their relief it is essential either to relieve the obstruction or to make feeding in other ways possible. Backache and pain are usually the result of involvement of surrounding structures. They are difficult to control and symptomatic relief may be all one can hope for. On the other hand dilatation of the stricture, X-ray treatment or establishment of a gastrostomy with consequent relief of esophageal obstruction and the associated stagnation and irritation may bring about the desired results.

### PALLIATIVE TREATMENT

Under palliative treatment the following measures may be adopted as indicated:

1 *General medical care* In early cases when swallowing is still possible a well balanced diet

should be arranged with all food finely divided to prevent stagnation. Attention must be given the heart and kidneys and bowel elimination aided. Adequate rest is of importance to preserve the patient's strength. In all advanced cases the most important consideration is the administration of adequate quantities of fluids to overcome dehydration and toxemia. One may resort to hypodermoclysis, proctoclysis or venoclysis. The addition of 5 per cent glucose to any of these is helpful. Whether to tell the patient of the nature of his illness has to be judged in the individual case. Inasmuch as most patients are men it is frequently advantageous to do so in order to gain their co-operation and to enable them to arrange their affairs. If one has the impression that such knowledge will lead to severe mental depression it may be better to withhold the information.

2 *Gastrostomy* This should not be reserved as a last resort but be performed in most cases soon after a diagnosis has been made. Though it is a relatively simple operation which may be done under local anesthesia with a low mortality in patients in fairly good general condition it is much more dangerous in an emaciated dehydrated individual with poor healing power. Patients frequently object to such an operation because of the annoyance of constantly wearing a tube and the necessity of having all food administered that way. To overcome these objections it is recommended to do a *Janeway gastrostomy* which does not require the use of a tube except at meal time and which usually does not leak. After it has been in use a short time and the esophagus has been put at rest, the swelling due to irritation associated with the carcinoma may subside and the patient be able to swallow better than before. In all complete obstructions gastrostomy is a temporary life saving measure.

3 *Dilatation* In some clinics this method is used in preference to most others. If carefully performed by passing bougies over a previously swallowed silk thread or under guidance of the

eye through an esophagoscope, there is probably not much risk connected with it in trained hands. Unless one is an expert, however, perforation with a fatal outcome may result. It gives temporary relief only.

4 *Intubation* After a carcinomatous stricture is dilated, it is at times possible to insert a tube, which maintains the lumen permanently. These tubes vary in size and are made of rubber or metal. Their introduction requires skillful manipulation and should be attempted only by experts.

5 *Radiation therapy* Although classed with the palliative measures it is really intended to be more than that. One's aim is to destroy the tumor either by means of deep roentgen therapy or by the insertion of radium capsules or radon seeds. Unfortunately, such happy results have not been attained so far, but with the modern treatment developed at some clinics considerable relief and probably prolongation of life may be looked for. Radiation therapy may, of course, advantageously be employed in combination with dilatation, establishment of a gastrostomy or other treatment.

6 *Electrocoagulation* In selected cases, especially those with an elevated polypoid type of tumor, destruction of the growth may at times be accomplished. One has to be very careful to select only such cases in whom the growth is small and superficial, because the destructive action of the coagulation may easily lead to perforation.

#### RADICAL SURGICAL TREATMENT

Because of the different problems encountered in different portions of the esophagus, it is best to consider treatment under the headings of (1) carcinoma of the cervical portion of the esophagus, (2) carcinoma of the thoracic portion of the esophagus, (3) carcinoma of the lower esophagus and the cardia.

1 *Carcinoma of the cervical portion of the esophagus* The lesion may affect the esophagus alone, but it usually extends into the hypopharynx and frequently also involves the larynx. It may be impossible to say where it originated. In all such extensive cases complete extirpation of the upper end of the esophagus, the hypopharynx, and the larynx, together with associated lymph nodes, is the operation of choice. It insures thorough removal of affected tissues with a chance for permanent cure. The tracheotomy remains permanently, but the pharynx may be reconstructed later by the method advocated by Gluck with more or less successful power of deglutition. The pleural cavities are not opened. A preliminary gastrostomy should be done. Colonic

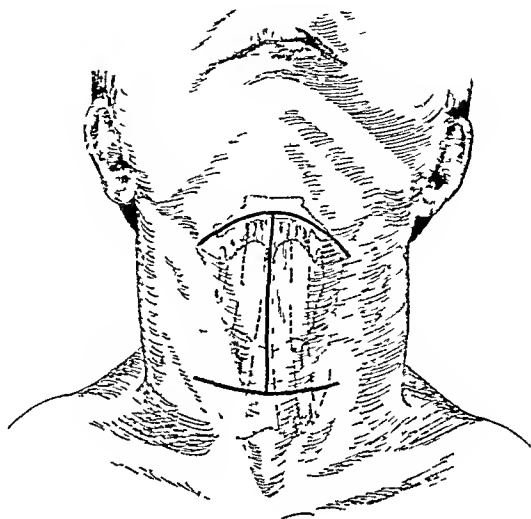


Fig 1 Skin incision

anesthesia is of great help, it may be supplemented through the tracheotomy after the trachea has been divided. The steps of the operation are as follows.

A transverse incision is made at the level of the hyoid bone, another one just above the clavicles, and both then are united by a median vertical incision (Fig 1). The two skin flaps so outlined are dissected back and the sternohyoid, sternothyroid, and omohyoid muscles divided. The sternocleidomastoid muscles are retracted laterally. After this the isthmus of the thyroid gland is divided and the two lateral lobes dissected back (Fig 2). In case there are enlarged lymph nodes, they are freed by block dissection, leaving them attached to the specimen to be removed. The larynx, trachea, pharynx, and upper esophagus are now completely freed from the spinal column. If a one stage operation is contemplated the further procedure consists of division of the trachea just below the larynx and the esophagus below the tumor (Fig 3). Suction may be used advantageously at this time to avoid spreading mouth or tumor secretions. Strips of iodoform gauze or gauze saturated with novocain 4 per cent is immediately packed into the larynx and pharynx from below. The tracheal stump is now drawn forward and fastened into a small slit cut into the lower skin flap just above the suprasternal notch, the aim being to direct the opening forward. The esophagus stump is sutured to the margin of the skin, thus leaving a skin bridge between the two openings, which helps to prevent secretion running into the trachea (Fig 4). Firm

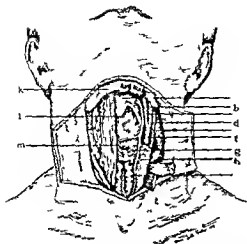


Fig 2 a Thyro-hy d memb a e b sup nor thyro d art ry c intern l car tid a tery d external carotid rtery e j gular v in f c rimon carotid art ry g cricothy d muscl h thyro d gla d isthmus of thyro d gland divided h by d bo e f larynx m cr cothyro d ligament.

traction upward on the larynx and upper esophagus stump now makes further separation of the specimen from the spine easy and after dividing the thyrohyoid membrane and the posterior

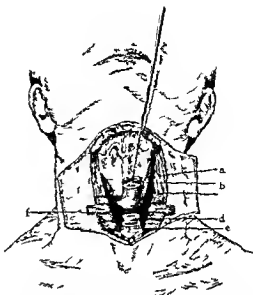


Fig 3 The upper st mp f the di ided t a hea and sophag a e tilt d pward. Upper st mp of trachea b pha ynx c upp r stump f soph gu d low r stump of sophagus e lower st mp f trachea f t tropharyngeal sp c

pharyngeal wall it may be removed. If possible the pharynx is now completely closed above otherwise it is closed incompletely and a small tampon inserted. Spontaneous healing takes place later. The skin flaps are now reunited and

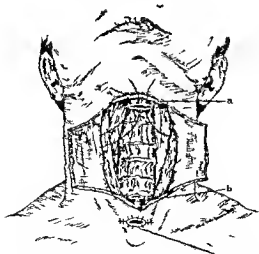


Fig 4. Larynx a d esophagus rem ed. a Pharynx bo t t b closed b tump f esoph g c t mp f trachea b ught fr m rd a d sew d it lit of ka bel w es phagus

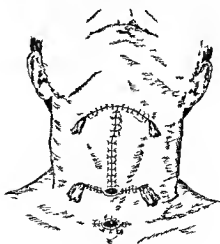


Fig 5 Incisio ca sed small gau t mpo erted a to angl of wo nd

adequate drainage is established to prevent pocketing (Fig 5). After complete recovery has taken place (Fig 6) one may attempt reconstruction of the pharynx. The skin of the neck is used for this purpose. The pharynx is reopened. Two vertical incisions are made extending from either side of this newly made pharyngeal opening to either side of the esophagus opening, and the skin margins are united to form a tube (Fig 7). The outer skin margins are now undermined and united over the newly formed tube as well as with the pharyngeal opening above and the esophagus below (Fig 8).

In case the patient has been very much weakened by disease, or for technical reasons, to avoid spreading of mouth infection into the mediastinum, it may be well to divide the operation into two stages. The first stage ends with the mobilization of the entire mass to be removed. One of two courses may be followed after that. The first method consists of surrounding the mass with strips of iodoform or vaseline gauze with special reference to favoring development of adhesions downward. The skin is then closed over it. The other method consists of drawing the larynx and pharynx forward and uniting the skin flaps behind them, thus exteriorizing them. Seven to 10 days later the specimen may be safely removed and the openings cared for as described.

The operative procedure may be varied as indicated. Occasionally the tumor may be very small and limited to the upper esophagus. In



Fig 6 Complete resection of larynx, upper esophagus, and hypopharynx

such a case resection of the tumor bearing area alone may suffice. It may be possible to draw the esophagus upward sufficiently to re-establish union with the pharynx, at least posteriorly, and depend on epithelization anteriorly to give a

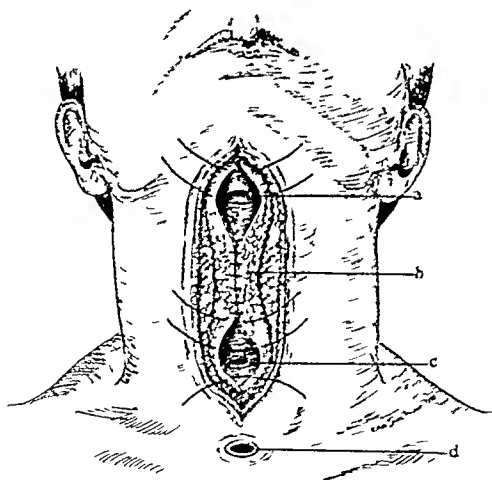


Fig 7 Reconstruction of esophagus a, Pharyngeal fistula, b, new skin flap about to be fashioned into a tube, c, esophageal fistula, d, tracheal stump

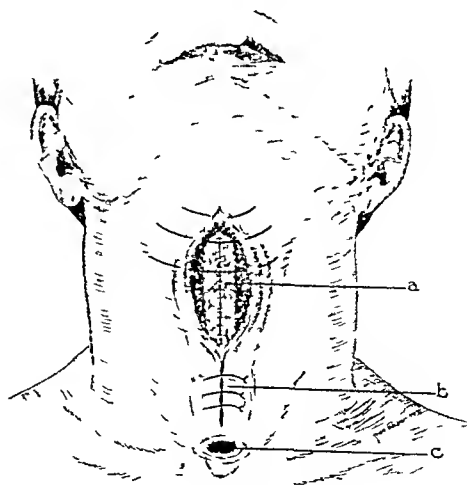


Fig 8 Esophageal plastic finished a, New esophageal tube, b, skin flaps sewed over tube, c, stump of trachea sewed into slit in skin



Fig 9 Incision along the right place of the tumor

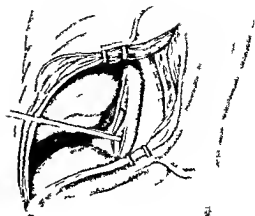


Fig 10 Chest dissection showing the isolated pleura and phagus isolated

satisfactory canal. Any of these operations, however, are apt to be incomplete and may be followed by a recurrence or contractures may take place which seriously interfere with deglutition. Therefore the most desirable method seems to be to plan big and to follow the procedure herein outlined.

*Caesura of the thoracic portion of the esophagus.* Numerous methods have been suggested and tried but have been given up because of difficulties encountered and of unsatisfactory results. The operation which has been followed by more operative successes than any other is that devised and first performed by Trendelenburg. It is a transpleural procedure. The important points of which are a preliminary gastrostomy, wide thoracotomy for adequate exposure, division of the esophagus below the tumor with closure of both ends, drawing the upper end out at the neck through a separate incision and closure of the chest. The steps of the operation are as follows:

Under general inhalation anesthesia with differential pressure to control expansion of the lungs the patient is placed on his right side and an incision is made throughout the length of the seventh intercostal space. From the posterior end the incision is carried upward and the seventh, sixth, fifth and fourth ribs divided near their

tubercles (Fig 9). After a rib spreader is inserted a wide exposure is obtained (Fig 10). In case pleural adhesions are present they are divided and the lung is then held aside. The pleura is now divided over the mediastinum from the lower border of the arch of the aorta to the diaphragm and the esophagus with the tumor is identified (Fig 10). The tumor may be located anywhere below the arch but in our experience has been found most often behind the arch of the aorta. By careful dissection the esophagus with the tumor is freed out of its bed. This is often very difficult especially with a tumor situated behind the arch. All vessels crossing the esophagus or running into it are doubly ligated and divided. The vagus nerves are pushed away but branches incorporated in the tumor or passing over it have to be sharply divided. A double strong silk ligature is now applied to the esophagus at a safe distance below the tumor and the organ is divided with a cautery. The lower stump is invaginated into the remnant of the esophagus or into the stomach by means of a pursestring (Fig 11). After incision of the pleura above the arch and the freeing of the esophagus in this location the upper end is drawn upward from behind the arch (Fig 12). Without difficulty the normal upper esophagus is now freed by blunt dissection as far as the neck. The chest wound is temporarily closed with towel clips and the patient's body is rotated somewhat toward the left in order to expose the neck. Great care in asepsis is required at this time in order to avoid contamination. Fresh draping is in order. An incision about 3 inches long is now made on the



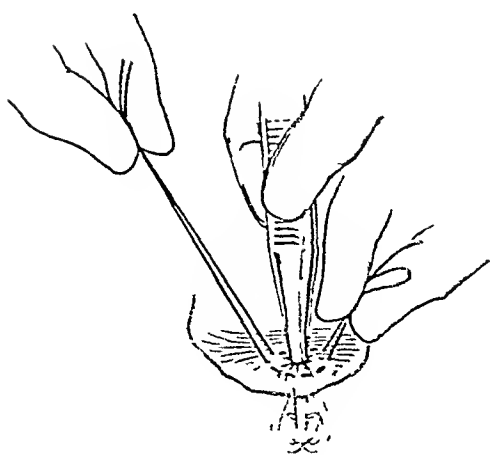


Fig. 11 The burying of the lower stump into the stomach by means of a purse-string

left side of the neck in front of the lower border of the sternocleidomastoid and deepened in the direction toward the esophagus. About this time the patient may again be rolled more onto his side and the chest wound reopened. One hand inside, following the esophagus upward, aids greatly in identifying the esophagus in the neck. A clamp is passed down, grasps the silk ligature attached to the stump and the esophagus with the tumor is drawn out of the neck wound, wrapped in gauze and temporarily left there (Fig. 13).

The tissues at once close snugly about it. The rib spreader is now reinserted and the thorax inspected. The lungs should be brought to full expansion by increasing the pressure in the bag. It has been found that this acts as the best known stimulant for the circulation. For this reason it is recommended that such expansion be resorted to from time to time during the operation, especially when the circulation is at low ebb as the result of manipulation of the esophagus behind the arch of the aorta. Before closure of the chest the mediastinal pleura is closed with continuous plain catgut suture, both above and below the arch. To prevent slipping of the divided rib ends later on, it may be well to have holes drilled before they are divided and to use them for exact approximation. However, slight overlapping does no harm. The intercostal muscles are united with continuous fine chromic catgut. The muscles of the chest wall are closed in layers with chromic catgut, and the skin with continuous plain catgut. A small, snugly fitting dressing is applied with adhesive plaster to prevent exposure of the long incision.

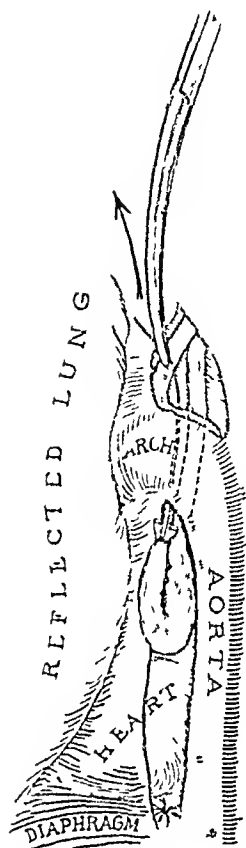


Fig. 12 Esophagus has been divided. Upper end with tumor is being drawn upward behind the arch of the aorta

The patient is now turned on his back, and attention is directed to the esophagus stump which emerges from the neck wound. It is proposed to place the normal portion of the upper esophagus, remaining after removal of the tumor, into a subcutaneous tunnel. One therefore judges this length and makes a small transverse incision over the left anterior chest wall at this point, which usually corresponds to about the second intercostal space. A tunnel is formed bluntly and the entire specimen drawn through (Fig. 14). The tumor is now removed, leaving the esophagus stump project a short distance to allow for retraction or possible necrosis. It is fastened to the skin with a few silk sutures. After closure of the skin incision in the neck with silk sutures the operation is completed. The patient is usually in severe shock. Administration of fluids, a hot coffee enema, and possibly a transfusion are given.



Fig 3 Esophagus has been secured: the neck and big end with the undraining tube

The question whether to drain or not to drain has to be decided in each case. It may be helpful and does no harm. A snugly fitting drainage tube is therefore inserted through a stab wound in the eighth or ninth intercostal space before the thorax is closed and the end of the tube is kept under fluid level. It has the advantage of permitting full expansion of the lung at the end of the operation. The lung usually remains fully expanded as can be determined by x-ray examination. The drainage tube may be removed as soon as pleural exudation ceases to develop. Gastrostomy feedings may be resumed early. However with a view to avoid overdilatation and possible leakage at the site of the inverted esophageal stump it may be safer to delay a few days. As soon as practicable a rubber esophagus may be used connecting the upper stump with the gastrostomy (Fig 15). In case the patient recovers one may later consider construction of a subcutaneous esophagus from the skin of the chest wall.

3. *Carcinoma of the lower esophagus and the cardia*. Theoretically considered operations for lesions in this location offer a better outlook than carcinoma of other portions of the esophagus because it is technically possible safely to implant the esophagus stump into the fundus of the stomach and thus reestablish a normal canal. No gastrostomy is required. If desired however it should be placed near the pylorus in order not

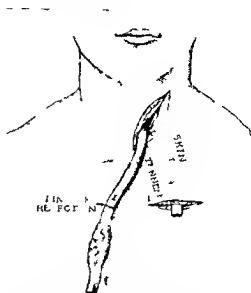


Fig 14 Stomach in the abdominal cavity with the tube placed in the stomach and the esophagus stump in the pleural space

to interfere with proper mobilization of the stomach which is essential to a successful operation. A jejunostomy may also be considered. The operation may be done from below or from above the diaphragm. Individual preference may be the determining factor but if one considers that the abdominal operation is less shocking than the thoracic one the former method should be chosen in suitable cases. The real deciding factor should be the position and extent of the tumor. Unfortunately these cannot always be determined in advance. If the lesion involves the esophagus to above the diaphragm a transthoracic operation should be done. On the other hand if the cancer is confined to the cardia and encroaches but slightly on the subdiaphragmatic portion of the esophagus sufficient mobilization may be obtained from below to make a safe suture possible. The size and rigidity of the thoracic cage also have to be considered. The abdominal approach is more suitable for women with a flexible thorax rather than for men with a large emphysematous chest.

A *abdominal method of esophagogastrostomy*. Under general inhalation anesthesia a median epigastric incision is made which is carried upward in the notch to the left of the ensiform as far as possible (Fig 16a). After the left lateral ligament of the liver is divided that organ is displaced to

the right and good exposure of the under surface of the diaphragm is obtained (Fig 16). Only rarely is an osteoplastic resection of the left costal arch required to get the necessary exposure. The vessels of the lesser and greater curvature are now doubly ligated and divided beyond any suspicious lymph nodes. After this the stomach is divided between clamps well below the tumor and the lower end closed by suture, while the clamp may remain attached to the upper end until the specimen is removed. If a de Petz sewing machine is available it will shorten this step of the operation considerably and aid in the preservation of asepsis. Further separation of the tumor is now continued, posteriorly it may be difficult to secure separation from the pancreas and laterally from the spleen. When finally accomplished the stomach with the tumor remains attached only to the esophagus. By passing a finger upward all around it, freeing it out of the hiatus, and at the same time making gentle traction, one may expose about  $2\frac{1}{2}$  to 3 inches without difficulty. This permits turning the stomach stump over and laying it on the chest wall, thus putting the esophagus on the stretch (Fig 17). With care neither pleura is opened and no other serious damage is done. The fundus of the stomach is now drawn upward behind the esophagus as far as possible and fastened there with a few silk sutures. This places the anterior wall of the stomach in contact with the posterior wall of the esophagus. A few additional sutures are now placed on each side of the esophagus fastening it to the stomach down to the place where division is contemplated. One of two courses may be followed now, depending on whether one prefers to implant a temporarily closed esophagus stump into the stomach in the hope of thereby preserving asepsis more completely, or whether one expects to carry out a circular suture between the open esophagus stump and the stomach. In case the former method is chosen the esophagus is doubly ligated with heavy plain catgut above the tumor and divided with the cautery. The specimen is removed. A small incision is now made into the stomach opposite the esophageal stump, and the latter inserted into it and fastened snugly into place (Fig 18). After this the stomach wall is drawn upward in front of the implantation to the level of the original sutures placed posteriorly. Sutures are now inserted between the stomach and the anterior wall of the esophagus as well as between the walls of the stomach itself until it fits firmly. An invagination of the esophagus into the stomach for a distance of 1 to  $1\frac{1}{2}$  inches is obtained in this way.



Fig 15 Esophagus and gastrostomy opening connected by means of a rubber esophagus

If one chooses to perform a suture between the open esophagus stump and the stomach similar to a gastro-enterostomy, a small incision is made into the stomach opposite the point on the esophagus where division is contemplated. The esophagus is divided and all secretions are removed by suction. Posterior sutures of interrupted fine silk are inserted through the entire thickness of both organs. If it is desired one may introduce a duodenal tube at this time (Fig 19). It is best accomplished by passing a stomach tube up the esophagus retrograde, attaching the upper end of the duodenal tube to its lower end and by gentle traction bringing it out at the mouth. The lower end of the duodenal tube is pushed into the stomach and guided through the pylorus until it is well down into the duodenum. The suture line is now completed anteriorly, the stomach wall drawn upward over it and fastened into place as described (Fig 20). The abdomen is closed in layers without drainage. Fluids may be administered through the tube in small quantities almost at once as there is probably no regurgitation from the duodenum into the stomach.

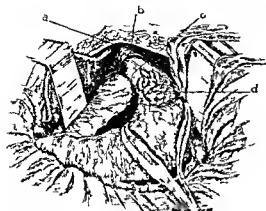


Fig. 6. Resection of the posterior esophagus and fundus of the stomach by the thoracic approach. The posterior esophagus is divided and the stomach is pulled down into the thoracic cavity. The diaphragm is then sutured to the posterior esophagus and the stomach.

**B Transthoracic method of esophagogastronomy.** The principle underlying this method is identical with that just described and consists of resection of the tumor bearing area followed by implantation of the esophagus stump into the fundus of the stomach. It differs from it chiefly in its approach. The operation as proposed and described in detail



Fig. 7. Stomach divided by anastomosis of the posterior esophagus. The stomach is divided and the posterior esophagus is attached to the fundus of the stomach. The posterior esophagus is then sutured to the fundus of the stomach.

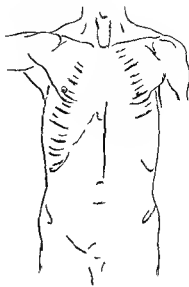


Fig. 8. Sk 1

by Fischer may be varied in regard to certain technical details as indicated in the individual case. In general the steps are as follows:

Under inhalation anesthesia with differential pressure a long incision is made along the left seventh or eighth intercostal space. It may be carried upward posteriorly to permit division of one or more ribs for better exposure. The mediastinal pleura is then incised, the esophagus above the tumor is mobilized and a tape is passed around it for traction. In order to relax the diaphragm which facilitates the subsequent fixation of the displaced stomach and makes the entire operation easier, the left phrenic nerve is crushed. This may be done any place in its path along the pericardium, preferably below. The diaphragm is now incised in the direction of its fibers and the incision is carried to the cardia (Fig. 21). This exposes the stomach and permits ligation of the vessels of the lesser and greater curvature. Gentle traction on the tape surrounding the esophagus as well as traction on the stomach aids greatly in freeing the cardia as well as the tumor from their surrounding adhesions.

In case the tumor is limited to the esophagus, a double ligature may be applied above and below the tumor, the esophagus divided between the ligatures at both places and the specimen removed. The lower stump is then inverted into the stomach and the upper stump transplanted into the fundus of the stomach. However, if the tumor

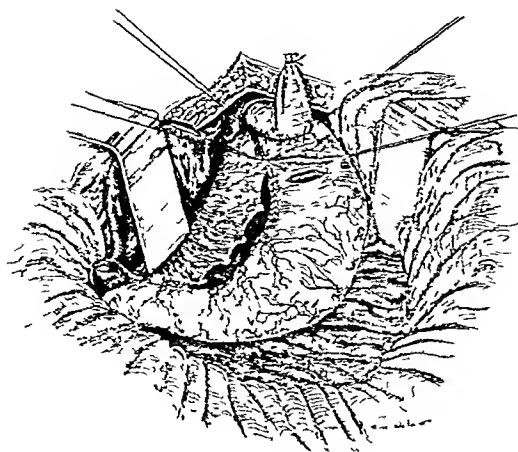


Fig 18 Tumor removed Esophagus stump closed, ready to be inserted into a slit made in anterior wall of stomach

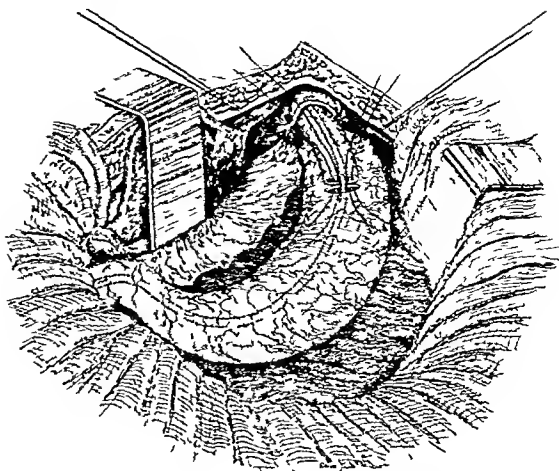


Fig 19 Tumor removed Esophagus stump about to be implanted into anterior wall of stomach by suture method Duodenal tube shown which is to be used for immediate feeding

is situated very low or if the cardia is also involved, there will not be a stump of sufficient length to permit inversion. In such cases it is necessary to take away a part of the stomach. Double clamps are therefore applied and the stomach is divided between them. The lower end is closed at once with a double row of sutures, while a clamp may be retained on the upper end. If a de Petz sewing machine is available it will be found ideal for this purpose. The esophagus is then doubly ligated and divided above the tumor, and the specimen is removed. One may, after that, proceed as described by Fischer, leaving the esophagus stump closed with a plain

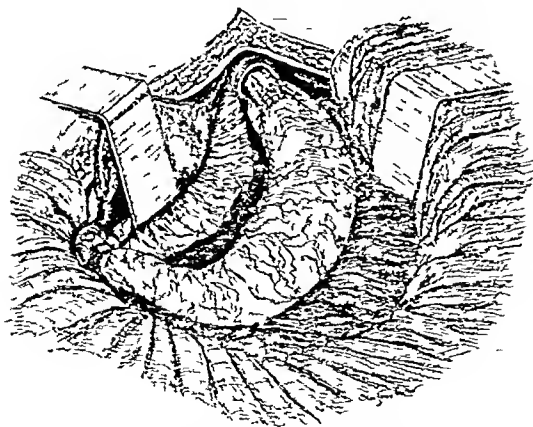


Fig 20 Implantation of esophagus completed by drawing up the anterior wall of the stomach over the suture line and fastening it in place well up on the esophagus

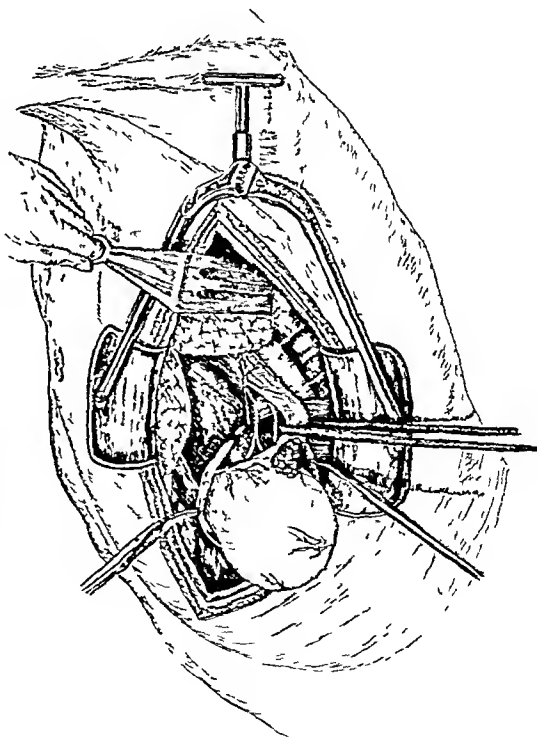


Fig 21 Transthoracic approach with division of diaphragm for exposure of carcinoma of lower esophagus or cardia (Drawing copied from Sauerbruch's *Die Chirurgie der Brustorgane*)



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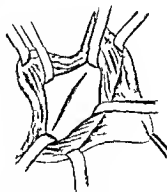
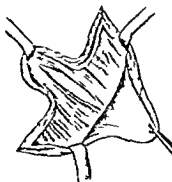
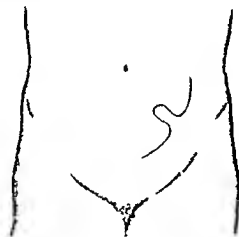
## PALLIATIVE COLOSTOMY

D. PHILIP MACGUIRE, AB, MD, FACS, New York, New York

□ at Presently 1500 15th St New York Post Graduate Medical School 1 House 1 Col mit Univ

**M**ORTALITY rate totalling 13.4 per cent in 500 cases of palliative colostomy was reported recently by W. B. Gabriel, surgeon at St Mark's Hospital, London, and O. V. Lloyd Davies, surgical registrar to the Middlesex Hospital, London. When such a high percentage

of death resulting from colostomy is reported by two of the foremost men in their field it should convince the general surgeon and occasional operator that he should give his undivided attention to the careful consideration of each typical case before he attempts to operate.



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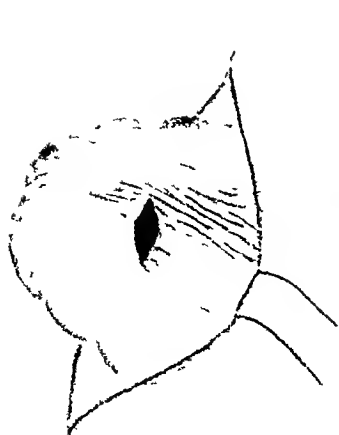


Fig 6

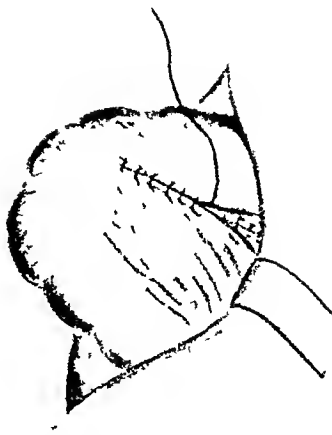


Fig 7

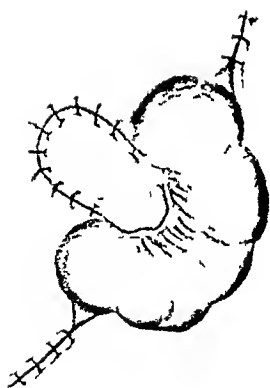


Fig 8

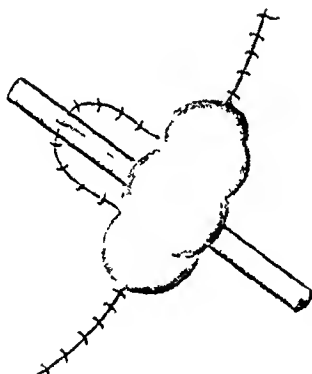


Fig 9

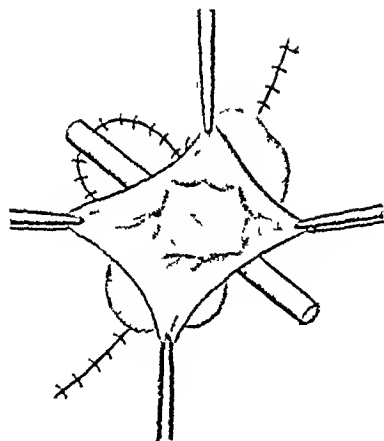


Fig 10

Fig 6 Bowel drawn down from above until it meets active resistance

Fig 7 Two layers of suture used in the lateral peritoneal fold. The deep suture is made with No. 1 chromic gut interrupted. The superficial suture is made with Pagenstecher silk. Two sutures are used because it is a notorious fact that in carcinoma of the abdomen the peritoneal fluid dissolves suture material readily. This also fixes the bowel firmly after being drawn down from above as in Figure 6.

Fig 8 Loop of bowel drawn out of the abdomen. The peritoneal layer has been sutured and the tongue shaped

flap of the fascia and skin is drawn through a hole in the mesentery some distance below the bowel level. The fascia is sutured with No. 2 chromic gut interrupted and the skin with silk or silkworm gut.

Fig 9 Glass rod  $\frac{1}{8}$  inch thick and 4 or 5 inches in length inserted through the opening in the mesentery of the bowel.

Fig 10 The bowel is opened with electric cautery after the parts have been properly protected by bird nest dressing of gauze. Experience has shown that an immediate opening gives the patient great relief from pain and relieves the distention with gas.

As far back as 1918 Killian and Kast of our hospital staff reported the presence of serious kidney dysfunction in the advanced malignancies. Serious toxemias are also encountered when only a palliative colostomy has been considered.

The necessity for daily blood chemistry determinations, blood cultures, blood counts using preferably the von Schilling method and urinalysis is evident since a certain percentage of patients are so toxic that the surgeon is often obliged to postpone the performance of the colostomy until the patient is in better physical condition.

Considering the fact that this blood determination is the basis on which a decision is made as to the advisability for performing an operation, the writer does not consider it proper to have the surgeon assume the risk of operation in these serious cases of carcinoma of the colon without the benefit of this previous diagnosis. The author will present a detailed account of his preoperative, operative and postoperative treatment for this condition in a future publication.

The illustrations appearing in this article show the salient features of the technique. Figures 1, 2 and 9 show the tongue shaped flap which when sutured strengthens the weakest portion of the incision thereby preventing consequent bulging, herniation and recession of the limbs of the colostomy.

Figures 7 and 8 illustrate the conclusive method for preventing herniation of the ileus and obstruction of the small intestines. A prolapse of the mucous membrane of the proximal limb of the

colostomy is prevented by the pulling down and fixation of the colon in the lateral peritoneal fold by the use of the Pagenstecher suture.

The skin and fascia edges are then resected as in Figures 2 and 3 so that no constriction of the bowel by these structures can take place. It is necessary to trim off the skin edges in order to avoid a late complication of stenosis due to fibrous tissue at the junction of the skin and mucous membrane.

The sensitiveness of the colon caused by the long standing disease prohibits the use of a rectal tube. When administering enemas of warm olive oil a No. 16 or 18 French catheter is utilized.

The patients suffering from cardiovascular and pulmonary disease constitute the largest group and present the most serious possibilities after operation.

The handling of these malignancies should be avoided since pathogenic bacteria invade the peritoneal cavity following the slightest trauma, thus of the growth and the attached mesentery.

Local anesthesia and cyclopropane with the McGill intratracheal catheter are the methods of choice in producing anesthesia in these poor operative risks.

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## POLE LIGATION IN THE TREATMENT OF HYPERTHYROIDISM

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**L**IGATION of the thyroid arteries in goiters was first utilized by veterinary surgeons for goiters in horses. The first ligations in man are said to have been undertaken by Luigi Porta in 1811 and by Blizzard in 1813. The latter tried to ligate the superior thyroid arteries and the patient died of hemorrhage. In 1814 Walter attempted this procedure and succeeded. Early operators obtained good results in vascular and parenchymatous forms of goiter. Kocher recognized in it a means of improving highly toxic patients and used it as a measure preliminary to the more radical operation. He believed that "by ligation of one artery there is an amelioration of the patient's condition. If two are ligated, the amelioration is greater. If to this we add the removal of one lobe, the amelioration is still greater. Ligation of all four vessels will very rarely suffice to cure the patient who is seriously ill with exophthalmic goiter." We have operated upon several patients who have had both superior and both inferior thyroid arteries ligated elsewhere as a measure intended to bring about a cure of hyperthyroidism and in none of these patients had a cure resulted. We believe, therefore, that ligations should be employed always with a view of improving the patient's condition, so as to permit a subtotal thyroidectomy to be more safely performed later.

Prior to the pre-operative employment of iodine in the preparation of patients with hyperthyroidism, as proposed by Plummer, there was a great deal of discussion about when preliminary pole ligation should be employed, in what type of cases it should be used, and whether or not it brought about real improvement in these cases. Within late years, there has been but little discussion of this subject, and there is an inclination to assume that this operative procedure is no longer needed in the surgical management of severely toxic patients.

Lahey has always found that the mortality rate in the surgery of hyperthyroidism is distinctly influenced by the number of multiple stage operations done. Superior thyroid pole ligation is one of the essential steps in multiple stage thyroid operations, it is applied only to patients in the most extreme stages of hyperthyroidism. Therefore it seems worth while to ascertain and report just what the actual results are in patients submitted to this operation, to discuss some of the indica-

tions for its use, and to describe our method of ligation.

While it has always been the opinion of one of us (FHL) that if a surgeon has operated upon enough patients with hyperthyroidism it should be possible for him to put in writing a description of the type of case in which a given measure, such as pole ligation, should be employed, nevertheless, in spite of the fact that we have made the decision to do pole ligation and have done it in 119 patients in 14,000 thyroid operations, in 75 per cent of which patients have been toxic, we have always found the description of this type of case very difficult. Hyperthyroidism is such a complex state, the disease affects different individuals and different age groups in such a varying way that it becomes extremely difficult to describe clearly the type of patient in which preliminary pole ligation should be done. One could, of course, if permitted to generalize to such an extent, say that preliminary pole ligation should always be done in all those cases in which it is thought fatalities would result if right subtotal thyroidectomies were done. One could likewise logically generalize further by saying that but one superior thyroid pole should be ligated when it is thought that ligation of both superior thyroid poles might result in a fatality. As a matter of actual practice and for the purpose of maintaining in a proper attitude the minds of those of us who have to make decisions as to multiple stage operations, Lahey has always insisted that the life of a patient who dies following a complete subtotal thyroidectomy, could probably have been saved had a first stage right subtotal thyroidectomy been done, following a right first stage subtotal thyroidectomy, the patient's life would probably have been saved had a preliminary bilateral superior pole ligation been done, and it is also true that patients who could not have survived a bilateral preliminary superior pole ligation would probably have been carried successfully through a unilateral pole ligation. While these are truly generalizations, nevertheless they do help one to maintain the proper attitude toward multiple stage operations in patients seriously affected by hyperthyroidism.

The fact that we have done pole ligations in 119 patients in 14,000 thyroid operations, indicates that the number of patients who are sufficiently toxic to require that procedure are

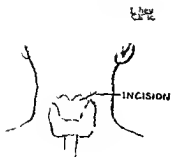


Fig. 3. Diagram of the external thyroidectomy (the incision).

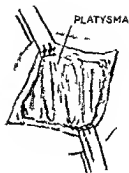


Fig. 4. The skin is retracted and the platysma is prepared.

but few in proportion to the total number. However, the fact that in the entire 14,000 thyroid operations but 85 deaths occurred and this includes deaths from cancer from emboli and from any other cause makes it obvious that while the group is small as to number it is important from the surgical standpoint for the patients are extremely ill and usually deplete risks.

In these patients in spite of fast, a high carbohydrate diet and Lugol's solution the pulse rate remains high—160, 170, 180—gain in weight can not be accomplished, activation is intense and the basal metabolism rate remains elevated or even increases. Of the three signs of severe hyperthyroidism the first two are distinctly the most dependable. Pulse rates are of course variable but when in the frank presence of severe hyperthyroidism the resting pulse on repeated observa-

tions is 160 or over, the question of a preliminary pole ligation must at least be seriously considered.

When in spite of a good food intake there has been a marked loss in weight and when in spite of an attempt to increase weight the patient still loses weight, preliminary pole ligation must be given serious consideration.

Basal metabolism estimation is in general a quite accurate indication of the degree of thyroid toxicity. It can be extremely misleading, however, particularly in that not infrequently dangerous degrees of thyroid intoxication with basal rates not higher than +18 and +24 have been noted. In general, high basal rates of true basal rates indicate high degrees of intoxication. While the reverse—that low basal rates indicate low degrees of intoxication—is in general true as

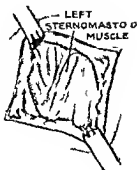


Fig. 5. The platysma is pulled down and the sternomastoid muscle is prepared.

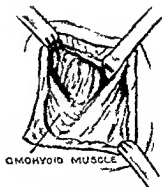


Fig. 6. The sternomastoid muscle is pulled down and the omohyoid muscle is prepared.

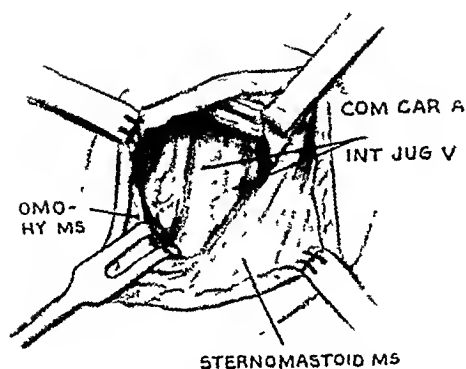


Fig 5 The sternomastoid retracted outward, the omohyoid retracted inward, the common carotid artery and internal jugular vein showing in the depth of the wound and the top of the thyroid with the superior thyroid artery and vein beside them

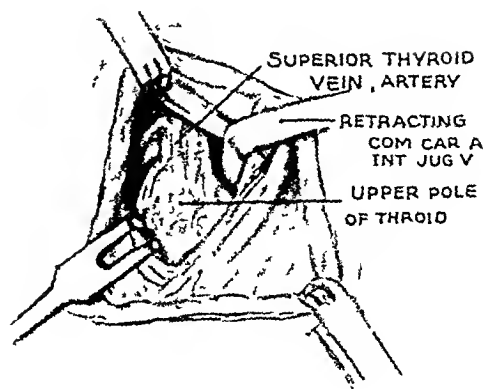


Fig 6 The common carotid artery and the internal jugular vein have been retracted outward thus exposing the top of the thyroid gland and the superior thyroid artery and vein

a diagnostic sign the low rates are much less dependable than the high basal rates

For many years Lahey has believed and preached that the degree of increase in basal metabolism is a fairly good index of the degree of hyperthyroidism but that it is notably unreliable as a criterion of operability. For this reason, we would again stress that the degree of elevation of the basal metabolism is not a dependable factor upon which to make the decision for or against pole ligation. Every one who deals with hyperthyroidism cases is familiar with the patient who, in spite of all measures to improve his condition, fails to improve or even becomes worse. This is the type of patient who, in spite of the obvious risk, must be subjected to some sort of procedure which may at least temporarily check the progress of the disease, it is the type of case in which pole ligation finds its greatest usefulness.

The patient in whom preliminary pole ligations are necessary is as a result of the primary hyperthyroidism, usually in a well advanced state of intoxication. Occasionally preliminary pole ligation will be employed in patients with toxic adenomas or secondary hyperthyroidism. However, the fact that secondary hyperthyroidism tends to occur in patients of middle age or past middle age who have less tendency to react to increase in combustion by activation makes one less apt to consider pole ligation necessary in these cases. The fact that the mortality rate of subtotal thyroidectomy in patients with toxic adenomas has always been higher than that for primary

hyperthyroidism suggests the possibility that because of the lack of excessive activation, hence of caution inspiring symptoms, we have not employed multiple stage procedures in a sufficiently high percentage of patients in this group.

We have learned from our large experience with toxic thyroid states that patients who run pulse rates of 200 or over while on the operating table are in a dangerous state of intoxication. Many patients with severe hyperthyroidism while on the operating table will for a short time show pulse

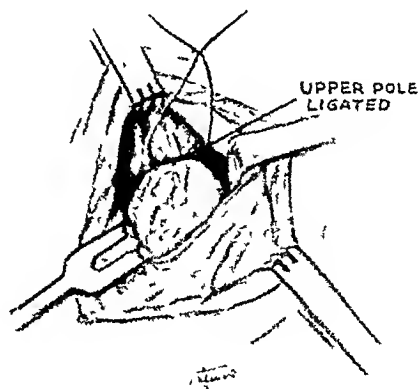


Fig 7 The same as Figure 6 except that the first ligation about the vessel has been tied and the second one passed about the poles. Note that the pole is so ligated off the gland that no gland tissue is included in the tie.

rates of 200 or more and still not die. If however one were to operate on many patients with hyperthyroidism who maintained such pulse rates while on the operating table the mortality rate would we believe be excessive.

In interpreting tachycardia in patients with hyperthyroidism while on the operating table it should always be remembered that there is often a preliminary rise in pulse rate as the result of the ordeal of anesthesia induction. Our anesthetists are accustomed to delay their opinion as to what the average pulse rate truly is until the patients are well past the stage of anesthesia induction and well under the anesthetic. Decisions made early in the anesthesia could well result in the performance of many more pole ligations than is actually necessary.

Pole ligations are employed in patients with the activating type of hyperthyroidism much more often than in patients with the apathetic type of hyperthyroidism and one must appreciate that the degree of activation must also influence the decision in the selection of the patient for pole ligation. In those patients who are excessively activated this procedure must always be given serious consideration.

We realize that our statements lack tangibility insofar as we have given a definite chain of signs and symptoms which should lead one to submit the sick hyperthyroid patient to preliminary pole ligation. In this connection we would repeat much as we dislike to state it that it is our opinion that no disease and no situation in surgery where the proper decision for or against multiple stage procedures and the selection of the proper stage operation are so dependent upon a large experience as in the case of patients in the acute stages of primary hyperthyroidism. If one be too cautious too many unnecessary pole ligations will be done if too reckless too many fatalities will occur. The results of experience which after all represent trial and error and the interpretation of the degrees of thyroid intoxication particularly cannot be so vividly set down on paper that this experience can be accurately passed on. As the result of this large experience we would like to express our final warning. If there is doubt as to whether a preliminary pole ligation or a right first stage subtotal thyroidectomy should be done in a patient acutely ill with hyperthyroidism the decision should always lean toward the more conservative procedure. After all if pole ligation be done and the patient survives but due to lack of reaction one is inclined to believe after operation that it was not necessary all that is lost is 6 weeks of time a recoverable matter. If a more radical

procedure is employed and a fatality results this is a non recoverable matter and as already stated the disturbing conviction remains that had the fatality occurred after a pole ligation the surgeon would be in a position to be less critical of himself.

Since this paper is written with the purpose of presenting personal experiences with the hope of aiding others who may not have had such a large contact with patients of this type we wish to peak finally of a factor which can and at times unconsciously does unfavorably influence decisions in multiple stage operations of all types and preliminary pole ligations in particularly severe cases. In most instances preliminary thyroid pole ligation is followed by a right subtotal thyroidectomy in 6 weeks and in 6 more weeks a left subtotal thyroidectomy. When preliminary pole ligation is decided upon in a given case the surgeon is conscious of the fact that he is going to put that patient through a three stage operative procedure. He is conscious of the fact that the patient, his friends and his family will be disappointed and possibly a little critical. He will be quite conscious of the fact that if the patients are a long way from home as they often are with us it involves a long time away from home and an increased expense because of the prolongation of the hospitalization.

Sentiment for the patient and a desire on the part of the surgeon to save the patient time and money have cost many a patient his life and have no place in the decision for or against multiple stage operative procedures in a patient sick enough from hyperthyroidism to have the question of multiple stage operations raised. There would be no pleasure in the practice of surgery without sentiment but it should be the type of sentiment which concerns primarily the protection of the patients life and not the imprudent type concerned only in saving the patient time and money at the risk of his life. We are strongly of the opinion that decisions for or against multiple stage operations should be made with rigid disregard as to whether or not the patient ever returns for the remaining stages as to whether or not the patient or family are disappointed or distressed and as to whether or not it occasions financial difficulties. Only two patients in our entire experience have failed to return for final operation. After all if the patient survives a pole ligation he will survive in practically all instances a right subtotal thyroidectomy and then a left subtotal thyroidectomy and his living presence and improved condition will be convincing evidences that easily outweigh any argu-

ments which may be made against the soundness of this position

The great vascularity of the gland and the very free arterial anastomosis would seem to make it theoretically improbable that a single or double ligation would materially reduce the blood supply to the gland. The main arteries are the superior and inferior thyroid arteries. These arteries anastomose freely and are not terminal arteries. The thyroid gland receives vascular supplies from the neighboring tissues such as the esophagus, trachea, prethyroid muscles, and subcutaneous tissues. This collateral supply is important because it is sufficient to prevent necrosis of the thyroid after ligation of all four thyroid arteries. Observations show that more blood passes to the thyroid through its four main arteries than to the brain through the internal carotids and vertebrals.

One of us (FHL) has often done preliminary ligation of the inferior thyroid artery, particularly in the past years before iodine was employed and when multiple stage operations were needed more often. Preliminary ligation of the inferior thyroid artery external to the large vessels and behind the sternomastoid before that vessel has divided into the transverse cervical and inferior thyroid artery, is a much more difficult operation than is ligation of the superior thyroid artery and necessitates a quite disfiguring, oblique scar of considerable length parallel to the posterior border of the sternomastoid, since it is necessary to have quite wide exposure here to identify the vessel and to avoid injury to the phrenic nerve in a cavity of considerable depth. It is, therefore, because of the fact that ligation of the superior thyroid artery can be done through relatively small transverse incisions located in the skin folds and so fairly non-obvious, that most surgeons prefer to do preliminary ligations of the superior rather than the inferior thyroid artery.

In preliminary ligation of the superior thyroid arteries, the operation is made extremely difficult if the incision is not so placed that it is directly over the point where the superior thyroid vessels enter the superior pole of the thyroid gland. One cannot say that the incision should be placed at such a fixed point as at the upper level of the thyroid cartilage. Anyone who is constantly exposing surgically the hyperplastic thyroids of patients with hyperthyroidism, is very conscious of the fact that there is a great variation in the size of these thyroid glands even in a group of patients with the same degree of toxicity. One patient in such a severe degree of hyperthyroidism that a preliminary pole ligation will be necessary

will have a small firm thyroid hardly larger than a thyroid unaffected by hyperthyroidism. The next patient with hyperthyroidism may have a hard, swollen thyroid at least eight to ten times the size of a normal thyroid. In such cases, there will be a variation in the level at which the tip of the upper pole will be found, and so it is necessary that the small lateral transverse incision through which the ligation is to be done be placed over the tip of the upper pole wherever it is and not at a fixed point.

To place the incision properly, one palpates the firm apex of thyroid tissue which forms the upper pole, by pressing it against the thyroid cartilage, and places the transverse incision if possible in a skin crease directly over this point.

Because of a desire to save patients unsightly scars, there is a tendency on the part of those not experienced with this operation to attempt to do this operation through incisions which are too small. This is a great mistake. Any patient who is sick enough to need preliminary pole ligation, needs to have the operation done as expeditiously as possible and with a positive certainty that the entire pole is ligated. Any patient who is toxic enough from hyperthyroidism to require preliminary ligation of his superior thyroid poles has a tremendously increased blood supply to his thyroid gland. It is not at all unusual in patients with severe hyperthyroidism to find a plexus of veins, each vein the size of one's little finger, over the superior thyroid poles. The upper pole of the thyroid rests directly against the internal jugular vein and common carotid artery. It is, therefore, obvious that a wide exposure of these structures is desirable until one has become very familiar with the technique of superior pole ligation and even then a good sized incision and wide exposure will usually be necessary.

A transverse incision is made through the skin over the upper pole wherever it is. A small branch of the cervical plexus and one of the anterior jugular veins is often encountered. The fibers of the omohyoid and sternohyoid are separated in their longitudinal direction and the fibers of the sternothyroid are cut across for the same distance as the skin incision. This brings one directly down upon the superior thyroid pole, and it is here that one needs to be extremely careful if he wishes to avoid complicating the entire procedure (Fig 1).

Lahey would urge upon the surgeon undertaking this operation to be certain that the entire superior thyroid artery and vein have been ligated and to do it within a relatively short operating time which demands one all important

TABLE I—LIGATIONS DONE

Year	Pole performed
1914	57
1925	
1926	1
1927	3
1928	0
1929	
1930	5
1931	11
1932	9
1933	3
1934	9
1935	

\*T. d. L. Ap. d. 93

thing namely that there be no venous hemorrhage. Once the large veins over the upper pole are torn and start bleeding the field becomes soiled the anatomy confused attempts to stop the bleeding incite further bleeding and with persistent efforts in a blind field the internal jugular can easily be torn and result in a serious situation. Each dilated branch of the superior thyroid veins is gently and carefully exposed and ligated until the pulsating superior thyroid artery comes into view. The internal jugular vein and common carotid artery are then gently separated from the upper pole of the thyroid and held away from it by a special deep narrow bladed retractor. A special spiral curved ligature passer which Lahey has devised threaded with No. 1 plain catgut is then passed downward along the lateral border of the thyroid cartilage outward around the back of the vessels and upward where the common carotid artery and internal jugular vein are held back by the retractor. The catgut is withdrawn from the passer and the pole is tied. The wound is inspected for bleeding and if none is present the omohyoid and sternohyoid fibers are permitted to fall together a few buried sutures of No. 0 catgut are put in the subcutaneous fat and the wound is closed with clips.

There are numerous theories as to how the improvement with pole ligation is obtained. Some are of the opinion that the greater part of the benefit from ligation is the result of a break in the nerve supply of the thyroid since the principal sympathetic nerve enters with the superior thyroid arteries. These sympathetic nerves have a marked vasodilatory and excretory action upon the thyroid. It does not seem probable that there is enough diminution of the blood supply to accomplish such improvement as frequently occurs. Others believe the blood supply of the gland is diminished and consequently the secreting power of the thyroid is

TABLE II—AGE INCIDENCE

Youngest Old	43 yrs 17 yrs	No. patients	Per cent
Between 10 to 20 years		3	6
20 to 30 years		3	6
30 to 40 years		9	18
40 to 50 years			0
50 to 60 years		12	24
60 and over		3	6
		5	

diminished. Still others believe that the benefit is due to a psychic adjustment to the operative procedures. It is impossible to arrive at any definite conclusion as to what brings about this improvement but it is possible to ascertain in what proportion of the cases the various evidences of improvement following the operation occur.

Over a period of 11 years from 1924 to March 1934 there have been 119 pole ligations performed at the Lahey Clinic. During this period there were approximately 14,000 thyroidectomies performed on all types of goiters. In all of the patients having preliminary pole ligation subsequent thyroidectomies have been performed ligation being employed only as an operation preliminary to thyroidectomy in toxic patients.

A series of 50 patients who have had pole ligations is presented showing the effect of pole ligation on weight gain, basal metabolic rate and pulse rate. There were 10 males and 40 females in this group which is approximately the same ratio as the incidence of hyperthyroidism in the two sexes. The youngest in this group was 14 years of age while 72 years was the age of the eldest. There were 22 patients between the ages of 41 and 60 years which is 44 per cent of the total. The age incidence is given in Table II.

In the patients studied in this series 33 or 66 per cent of the total had had the disease over 6 months while there was a question in 5 patients as to the duration of the disease. From other studies done at the Lahey Clinic it has been found that stage operations must be considered more often in patients who have had the disease over 6 months than in patients who have had the disease a shorter time.

Since we have always considered that duration of the disease influenced the operative risk rate it is interesting to note that 66 per cent of these patients had had the disease over 6 months.

Weight loss is the usual history in patients with severe hyperthyroidism. When patients lose weight with hyperthyroidism it is evidence that the excessive combustion is outrunning the



TABLE III—DURATION OF DISEASE

	Patients	Per cent
Duration unknown	5	10
1 to 6 months	12	24
7 to 12 months	15	30
1 to 5 years	14	28
5 years plus	4	8
	50	

TABLE IV—WEIGHT LOSS PRIOR TO ENTERING THE HOSPITAL

	Patients	Per cent
Indefinite	9	18
1 to 10 pounds	6	12
11 to 20 pounds	12	24
21 to 30 pounds	10	20
31 to 40 pounds	5	10
41 to 50 pounds	3	6
51 pounds plus	5	10
	50	

TABLE V—EFFECT OF LIGATION ON WEIGHT, PULSE, BASAL METABOLIC RATE—50 CASES

Changes in pulse and basal metabolic rate in those who gained weight after ligation—32 cases—64 per cent.

	Pulse	Per cent	B M R	Per cent
Decrease	20	62	23	72
No change	1	3	1	3
Increase	11	32	8	25

Extent of weight gain—

	Patients	Per cent
1 to 10 pounds	22	44
11 to 20 pounds	7	14
21 pounds	3	6

Changes in pulse and basal metabolic rate in those who lost weight after ligation—14 cases—28 per cent

	Pulse	Per cent	B M R	Per cent
Decrease	8	57	9	64
No change	1	7	1	7
Increase	5	35	4	28

Extent of loss in weight—

	Patients	Per cent
1 to 10 pounds	11	22
11 to 15 pounds	3	6

No change in weight in 4 patients—8%

patient's ability to take in enough fuel to offset it. This, then, means that the patient is consuming himself and that a true state of thyroid crisis will result if this state continues. It is of interest, therefore, in this group to note that seventy per cent of these cases had lost ten pounds or over. Table IV gives us the weight loss of the patients prior to their entrance into the hospital.

Following pole ligations the patients were sent to their homes for a period of from 2 to 6 weeks. During this time they received Lugol's solution,

TABLE VI—CHANGES IN PULSE RATE AFTER LIGATION

	Patients	Per cent
1 No change	2	
2 Increase—		
1 to 10	11	
11 to 20	4	
21 to 30	2	
Total	17	
3 Decrease—		
1 to 10	13	
11 to 20	9	
21 to 30	5	
31 plus	4	
Total	31	62

TABLE VII—CHANGE IN BASAL METABOLIC RATE

	Patients	Per cent
1 No change	3	6
2 Decrease—		
1 to 10	9	
11 to 20	7	
21 plus	17	
Total	33	66
3 Increase—		
1 to 10	7	
11 to 20	5	
21 plus	2	
Total	14	28

10 minims, daily. On return for subtotal thyroidectomy, 32 patients, or 64 per cent of the total number, showed a gain in weight. (See Table V.) Of these 32 who showed a gain in weight, there was a decrease in the pulse in 20 and a decrease in the basal metabolic rate in 23 cases.

Following ligation there was a decrease in the pulse rate in 31 of the 50 patients, or 62 per cent. This closely parallels the gain in weight which occurs in 64 per cent of the total.

We found that following pole ligation there was a decrease in the basal metabolic rate in 32 cases, 66 per cent, while there was no change in 3 patients and an increase in 14 patients.

#### CONCLUSION

Figures showing the improvement and failure of improvement following pole ligation are submitted.

Pole ligation is still of value as a procedure preliminary to subtotal thyroidectomy in patients with hyperthyroidism who are considered too bad risks for even right subtotal hemithyroidectomy.

An attempt has been made to describe the type of patient with hyperthyroidism in whom preluminary pole ligation should be considered

The method of ligating the superior thyroid pole which we have employed is described

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- 8 Id m Surg cal m tality f ophth lmic go t New York State M J 928 M pp 56-6

## THE DOUBLE (DIFFERENTIAL) STETHOSCOPE

AN AID IN DETERMINING THE STATUS OF THE INDIVIDUAL TUBES DURING THE PERFORMANCE OF RUBIN'S TEST

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ONE of the minor deficiencies of Rubin's test up to the present time has been the impossibility of determining with accuracy in every case whether a given lesion is situated in the left or the right tube and whether patency is present on one or both sides

The criteria which have hitherto been of most value in localizing tubal lesions during the performance of Rubin's test are as follows

1 *Pain* Patients with normal patency complain of no significant pelvic pain. They usually experience shoulder pain on rising but the side or sides on which the pain is experienced has been found to bear no constant relationship to the side of the tubal patency. In the presence of tubal stenosis or adhesions pain is usually felt during the test in the region of the diseased tube and may be unilateral or bilateral. If unilateral the differentiation between a normal and a closed tube on the opposite side is not always possible except insofar as the presence of one normal tube tends to overshadow a lesion of the opposite side by producing a normal kymographic curve. In the presence of complete obstruction of both tubes in the region of the cornua a typical graph is obtained and the patient complains of central abdominal pain in the suprapubic region which increases as the pressure is raised and is entirely relieved when the pressure falls. If the obstruction is in the region of the fimbrial end of the tube moderately severe distention pain is referred to the side on which the obstruction is present

2 *Abdominal auscultation* It has been customary to listen with the stethoscope over the hypogastric area during the performance of the uterotubal insufflation test. The sound of gas passing through the tubes intermittently in normal cases and almost continuously in the case of severely stenosed tubes is very characteristic and clearly audible. In the presence of complete closure of one tube the sound is usually most pronounced on the side of the patent tube but this sign is not always reliable as it is impossible with the ordinary type of stethoscope to listen on both sides of the abdomen at once. In discussing this question Rubin has said (3) Auscultation however is not absolutely diagnostic as the sound elicited may be transmitted to the side of the non patent tube. The purring huss or gurgling sound is as a rule more audible on the side of the patent tube. Speaking again as to the possibility of diagnosing patency in both tubes Rubin has also said (2) Unfortunately the sound is transmitted from the normal to the abnormal side so commonly as to make this physical sign unreliable for judging patency of both tubes

3 *Vaginal palpation* The performance of uterotubal insufflation should always be followed up by vaginal examination particularly in those cases in which lateral pelvic pain has been complained of during the test. In case a previously undiagnosed hydrosalpinx has been distended with gas during the test a tender swelling not present before will be felt on one or both sides thus providing direct localizing evidence

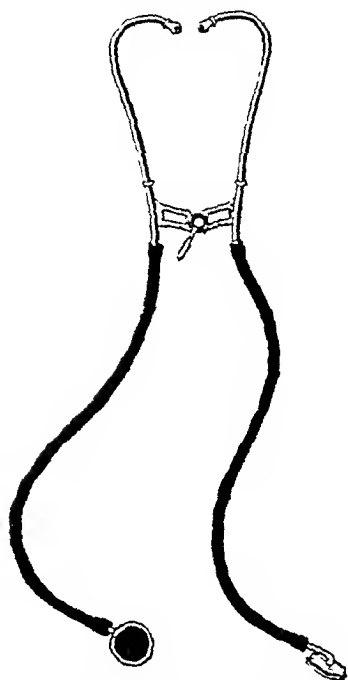


Fig 1 Double, or differential, stethoscope used for abdominal auscultation during the performance of Rubin's test

4 *Fluoroscopy and X-ray* Just as the side upon which shoulder pain develops has been found to have no localizing significance, so the presence of unilateral or bilateral subdiaphragmatic pneumoperitoneum has been shown to bear no constant relationship to tubal patency on one or both sides. Fluoroscopy is of value in some cases, however, in demonstrating an area, or areas, of decreased density in the pelvis, corresponding with unilateral, or bilateral, tender pelvic swellings, and to be interpreted as pneumosalpinx, or, perhaps more correctly, as pneumohydrosalpinx. An X-ray film taken of such a patient in the standing position will demonstrate a localized collection of gas, limited below by a definite fluid level.

I have felt for some time that the apparently not very complex problem of differentiating with greater certainty between tubal patency on one or both sides should be capable of a comparatively simple clinical solution and that the solution probably lay in the correct use of auscultation. In considering this question my attention became attracted to the principle of the double stethoscope, and accordingly I had a trial model of the instrument illustrated in Figure 1 prepared for me. The idea of the double or differential stethoscope

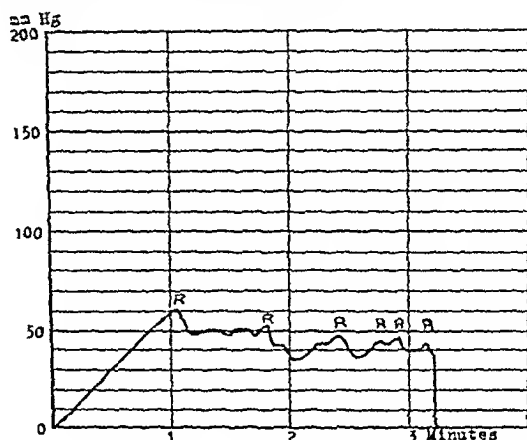


Fig 2 Insufflation graph after left salpingo oophorectomy for large ovarian cyst. Auscultation with double stethoscope reveals definite right sided bruit most pronounced at points marked R.

is by no means a new one, an instrument of this type having been first invented by Scott Alison (1) as long ago as 1858. The original purpose of the instrument was to enable sounds from different parts of the chest to be compared, but the method soon fell into disuse, and is now practically unheard of. In its proposed adaptation to the requirements of uterotubal insufflation, however, early experience seems to indicate that the double stethoscope may provide very real assistance in accurately differentiating between the status of the two tubes.

In using the instrument it is most convenient for the observer to stand on the right side of the patient, facing toward her feet, in such a position that the movements of the recording needle on the kymograph, if one is used, are plainly visible to him. The end of the stethoscope in contact with the left side of the patient's abdomen is thus connected with the observer's left ear, and that placed over her right side with his right ear. Differentiation is rendered easier if the two bells of the stethoscope are not held too close to the midline, but fairly well out toward the lower quadrant on each side.

In order, first, to test the possibility of differentiating the side of a single patent tube, a small series of patients were examined in whom it was known that one diseased tube had been removed, with conservation of the remaining healthy one. Independent colleagues, with no knowledge as to the type of operation performed, were then asked to auscultate during the performance of insufflation and to pronounce their opinion as to the



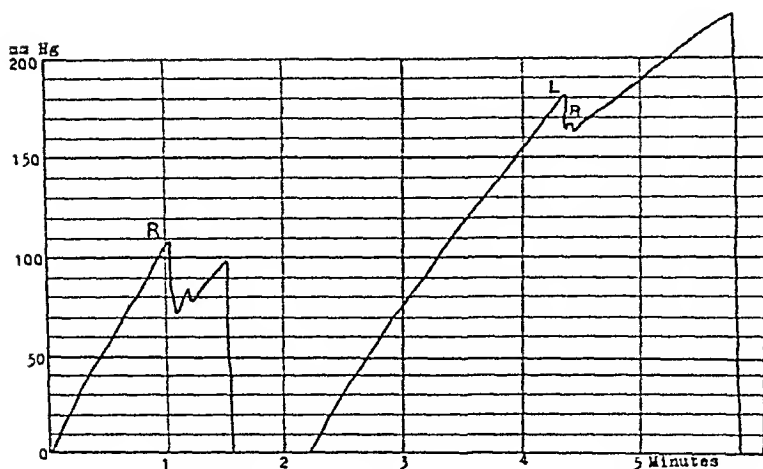


Fig. 4 Insufflation showing tubal non patency with development of bilateral pneumosalpinx. At the point marked *R* in the first graph the right tube was heard to fill with gas. In the second graph, at the point marked *L*, the left tube similarly filled, and immediately afterward a small additional amount of gas was forced into the right tube. Fluoroscopic and X-ray confirmation was obtained.

In normal tubal patency auscultation does not play so significant a rôle, but it is possible, by the double stethoscope, to distinguish between unilateral and bilateral insufflation of gas. In the ordinary form of bilateral patency sounds are heard indiscriminately from the right and left sides of the instrument. Sometimes the peak of a contraction wave will coincide with the commencement of bubbling from one side of the pelvis, sometimes from the other, and sometimes from both sides together.

By dictating the results of auscultation to another observer, it is generally possible to label any prominent falls in the pressure graph in terms of the passage of gas through one tube or the other.

The ultimate value of the double stethoscope in determining the status of individual tubes must await the pronouncement of various observers in large series of cases, controlled by lipiodol injections and actual findings at operation. Meanwhile the method is suggested as one which present limited experience marks out as possessing distinct possibilities, especially if used in conjunction with other localizing evidence.

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## URINARY OBSTRUCTIONS IN INFANTS AND CHILDREN

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**A**MONG the triumphs of scientific urology the mastery of the urinary tract in infants and children is outstanding. Little did the physician of a few decades ago dream that in such a relatively short time the depths of these organs would be probed with instruments introduced through the normal excretory channels nor that their physiological activities and pathological derangements would be revealed by the penetrating X-ray supplemented by the administration of opaque dyes.

The development and perfection of instruments of small caliber, the striking tolerance of infants and children to instrumentation when judiciously performed, and the co-operation of the pediatrician in seeking special investigation of the urinary organs in children creates a trinity designed to exert a tremendous influence in the development of infantile and juvenile urology.

The sole function of the excretory ducts of the urinary tract is to deliver the accumulated urine without impediment. Unfortunately obstructive conditions along the urinary pathways are exceedingly frequent and take as their points of predilection the normal physiological constrictions: (1) the ureteropelvic juncture, (2) the intravesical ureter, (3) the internal orifice of the bladder (this the most frequent).

Stasis is a natural accompaniment of such obstructive conditions. The problem therefore resolves itself into one of hydrodynamics. As a result of stasis infection is a natural expectation. These obstructive uropathies in infants contribute tremendously to infant mortality and should always be suspected in unexplainable cases of malnutrition, particularly if associated with urinary difficulties. Such suspicion may be confirmed by a determination of the nitrogenous constituents in the blood. If these are decidedly increased a prompt urological investigation should be undertaken and the cause, which is usually obstruction, be removed at the earliest possible moment.

Bugbee and Wollstein found 117 congenital lesions of the urinary organs in infants in review of 4,903 necropsies performed at the Babies Hospital in New York. Fifty per cent of these were due to some form of congenital obstruction. Thus 12 per cent of all the infant mortality occurred as a result of obstruction, either with or without infection, the most frequent location being at the internal orifice of the bladder.

Urinary infections in children are strikingly frequent. In the St. Louis Children's Hospital 1 in every 40 children either had such infections upon admission or developed them during the course of their stay. The majority of these were acute, the so-called acute pyelitis, usually secondary to some focal lesion elsewhere, the most common of which were middle ear, nasopharyngeal, pulmonary, in testinal or vaginal. Many of these acute conditions are cured following the relief of focal infections and the administration of urinary antiseptics and copious flushings. Such relief usually requires from 1 to 3 weeks. Urology at the present time is not serving its proper function with this type of acute kidney infection. Prompt ureteral catheterization with evacuation of the pelvic contents, followed by topical applications, as is currently employed in the adult, should be administered to protect the kidney substance from the ravages of infection squeezed back through it from the overcrowded pelvis which is incapable of emptying itself. The inability of the pelvis to evacuate its contents properly is in most instances not due to a pre-existing stricture but results from the acute inflammatory reaction with edema at the ureteropelvic junction secondary to the renal infection itself, a self-engendered obstruction. The longer the septic contents are allowed to remain permeating the delicate structural mechanism of the kidney, such a vital organ to human economy, the more likelihood of late scarring and irreparable damage with the formation of the framework of chronic lesions, chronic recurrent pyelitis and stone formation for years to come. In a personal communication with one of my confreres, Dr. Drennan, who is consultant at a reformatory for boys in the State of Illinois, I am informed that the presence of unsuspected pus and infection in the urine and of albuminuria and hypertension are exceedingly common and in almost every instance there has been a preceding history of pyelitis in infancy.

Chronic infections of the kidney are the ones which the urologist usually observes and those which have resisted the orthodox medical administrations. Children with such infections are never in good health. They are either persistently toxic or are subjects of recurrent intermittent infections with febrile reactions. In both instances some mechanical obstruction previously alluded to is usually the cause and must be investigated.

The persistence of medical treatment to these chronic infections was formerly due to lack of familiarity with the causative factors and to the failure of urology in offering material aid. At present, however, the remarkable curative results obtained through conservative surgical measures predict a brighter future for such afflicted subjects.

The clinical picture resulting from obstructions in the different portions of the urinary system may be very similar and the general physical signs may appear misleading. For instance, a child may present a large tender kidney and the whole symptom complex revolve around this one organ and yet the cause of this may be an obstruction in the lower urinary tract with both ureters and kidneys involved and only one manifesting the disease.

For practical purposes, and as an aid to the clinician, there are certain simple diagnostic procedures which may be helpful. First, the determination of total renal function by tests of elimination such as phenolsulphonphthalein or through tests of retention secured through a determination of the blood for its nitrogenous elements. If the total functional capacity is low, as indicated by these tests, one may be assured that both kidneys are involved regardless of the palpable evidences. Second, the determination of the presence or absence of residual urine is highly important. If residual urine is present, it is usually indicative that the condition results from obstruction at the internal orifice of the bladder and is in all probability bilateral. Third, the cystogram may afford valuable information in revealing the topographical outline of the urinary system. The fundamental lesion is at the bladder neck, if, upon filling the bladder, there is regurgitation up the ureters. Fourth, intravenous urography may be serviceable in delineating the outline of the urinary system but in my experience it has not been entirely reliable. I have seen it demonstrate normal pelvis when pronounced hydronephrosis was present, and it is usually impossible to determine whether a dilatation of the ureter results from retention of excretion or regurgitation. Fifth, cystoscopic investigation of the urinary tract is usually necessary before any definite plan of corrective therapy may be satisfactorily applied, and it is indeed gratifying that children tolerate cystoscopic manipulation so admirably. Reactions are seldom observed, indeed, they occur far less frequently than with the adult, if the child is properly prepared. The infant or child with high residual urine and uremia requires the same special preliminary catheter drainage before such

procedures are undertaken as is commonly employed in the adult. In hundreds of children whom I have examined, there has been but one serious reaction and this occurred many years ago in a child who was suffering from double chronic pyelitis without obstruction.

Anesthesia is required in only 35 per cent of the cases. If one is patient with these children, secures their confidence, and allows the mother to be present with them during the examination, there is seldom any difficulty in making a complete urological investigation even in very young children without general anesthesia. If general anesthesia is necessary, it is applied only for a few moments during the instrumentation and should be removed as quickly as possible for functional studies and pyelographic determinations. The preponderance of girls over boys minimizes the necessity for general anesthesia but even in very young boys such manipulations may frequently be consummated under local anesthesia.

Obstructions at the ureteropelvic juncture are the least frequent but most destructive. Large hydronephroses or pyonephroses are the inevitable result. They are often bilateral, one side being more pronounced than the other. They are less influenced by dilatations and require either nephrectomy or some plastic surgical procedure. A two-stage nephrectomy is usually necessary for the large pyonephrotic kidneys. The preliminary drainage allows the child to be relieved of sepsis, and the secondary operation is not complicated if performed within a reasonable time. The most frequent cause of such lesions at the ureteropelvic juncture are congenital strictures and aberrant vessels, the latter offering the best chance for recovery by simple ligation of the vessel which is obstructing. For ureteropelvic stricture with extrarenal hydronephrosis with or without infection and with preservation of renal cortex, I have found the resection of the ureter with excision of the stricture and resection of the renal pelvis with reimplantation of the ureter into the dependent part of the pelvis to be the most satisfactory surgical procedure. The ureter is united to the pelvis over a soft rubber catheter splint which is brought back through the renal cortex for drainage and passed well down the ureter. Into this catheter splint numerous openings are made to allow for drainage and very fine sutures are placed at the line of union, simply enough to insure stability. These should be fortified by traction sutures which are placed a goodly distance above and below the line of union. The kidney pelvis is freely drained through the cortex by means of a large catheter.

TABLE I—ESSENTIAL FEATURES IN 26 CASES OF OBSTRUCTION

Symptoms		Findings		Case	
Ud				5	
215				9	
55				8	
0				4	
Me				4	
1 ml					
Symptoms		Findings		Case	
F	en			13	50
D	ly			8	
In	in			3	
I	d	ng		7	
I	m	ua			
I	ur	d	pt	8	69
R	l			3	
Ur	ma			6	30
I	la	gm	i	6	
R	es	f	u	2	50
O	oo	cm			
N	es	l		3	
N	h	le		3	
Symptoms		Findings		Case	
U	at			0	4
V	es			2	6
V	l	l			0
V	l	f	ba		0
V	l	ma	n		0
I	l				0
Symptoms		Findings		Case	
R	at				
R	l				
D	ri				
S	t				
C	f				
I	f				
I	k				
R	g				
R	f				
K	h				
L	et				
R	g				
R	g				
R	k				
R	k				

Obstruction at the intramural ureter are susceptible to dilatation with the catheter and many are cured in this way. Others of a more sclerotic nature seem best treated by the transperitoneal operation which I described in 1919. This operation is an intravesical one requiring little manipulation and dissection. The intravesical ureter

which is sclerotic and often like a pig stem is excised from its vesical bed but its attachment at its entrance to the bladder wall is allowed to remain. This seems far superior to a ureterovesical anastomosis which is almost invariably attended by contracture by fibrosis and ultimate renal death.

The most common cause of chronic pyelitis in infants and children is obstruction at the internal orifice of the bladder resulting from congenital valves or contractures. Table I and the following pages give the essential features in a series of 26 cases of such obstructions.

The importance of regurgitation of the vesical contents into the ureters and kidney pelvis can not be overestimated. It was present in 46 per cent of these cases. One half of these occurred in the presence of a high residual urine, the remaining half with small residuals. It is evident therefore that the presence of a high residual is not essential for the creation of such regurgitation. Stiffening and retraction of the ureterovesical valve resulting from infection is fundamental. I have observed incompetency of the ureteral valves with large regurgitant ureters in several patients before operation, which after the relief of obstruction and subsidence of infection became competent and regurgitation did not occur.

**Operations.** Operations were performed in 16 of these children. Fourteen cautery punches and two suprapubics. Six were for valves, 1 for valve and bar, 7 for contractures of the vesical neck and 2 for kinks. The child's punch was used in 9 instances and the baby punch in 5.

**Preliminary treatment.** All of these little patients who carried residual urine and who had evidence of urosepsis were treated in a manner similar to the prostatic by preliminary indwelling catheter drainage, copious flushings and urinary antiseptics, oftentimes by the administration of subcutaneous saline and intravenous glucose and occasionally by transfusions until their condition appeared sufficiently satisfactory for any type of surgical operation. This type of preliminary treatment is just as important in children as it is to the prostatic. The operation is never performed until the nitrogen is normal, the febrile reaction has subsided and the general appearance of the child is good.

**Technique of operation.** The punch with its fluorator is passed into the bladder which has been previously filled with sterile water. In the infants the baby punch and 14 French size is used and in larger children the child's punch and 18 instrument is employed. Following the introduction of the instrument the bl-



turator is removed, the instrument gradually withdrawn until the water ceases to flow. One is then assured that the vesical orifice is within the slot of the instrument. Previous cystoscopic examination has determined the exact nature of the obstruction, and if it is a contracture of the neck, the slot of the instrument is brought out in the midline below. The eye-piece of the instrument is lightly elevated, steadily securing the obstructing orifice within the slot, the tube is evacuated and dried with a cotton pledget, the orifice is visualized by reflected light and the working element carrying the cautery blade is passed through the sheath of the instrument until it engages the obstruction, the heat is then turned on and by a rotary motion the obstructing band is punched out. The instrument is then removed unless further removal is deemed advisable. At times three bites are removed, seldom more. In case more bites are required, the instrument is reinserted into the bladder, water allowed to flow, orifice grasped again lateral to the previous bite at 5 or 7 o'clock on the dial and the procedure repeated.

In cases of valves, which are always lateral, the instrument is inserted in the same manner but the slot of the instrument is pressed toward the side from which the operator expects to remove a central section from the band, the eye-piece of the instrument passing in the opposite direction until one appreciates a hang and the water ceases to flow. The same process of removal is undertaken. Usually in the valve cases only two incisions are necessary, one on each lateral valve.

In none of the patients operated upon by the punch has there been the slightest bleeding. A small indwelling catheter is inserted for 24 hours. There has never been a postoperative hemorrhage and in only one instance was there the slightest febrile reaction. These children have tolerated such operations much better than have the adults. No complications have occurred. The operation is of course delicate and heavy pressure must not be exerted for fear of cutting too deeply. With light cauterization, there is no danger of deep penetration of heat with the creation of slough beyond the field of operation. The high frequency current as a means of resection would be extremely dangerous in tissues so thin and delicate.

The after-care consists in accurate supervision, daily passing the catheter for vesical instillation of some mild germicidal solution and for the determination of the emptying ability of the bladder. If the bladder empties completely, all instrumental manipulation ceases. If some residual remains as a result of edema, catheterization and



Fig 1 Contracture of the bladder neck and valves with dilatation of the urethra, marked trabeculation with cellulitis

instillation continue until it entirely disappears. If within 10 days the urinary function is not normal and residual is still present the child is re-examined and another operation performed. This has only been necessary in two instances.

The two suprapubic operations were performed a number of years ago, before the baby punch was perfected and would not have been necessary at the present day. Since these obstructive conditions in children are either from contractures or valves, there should seldom if ever be the necessity for an open operation for their removal.

Results. Thirteen of the operations have given perfect results, 2 decided improvement but not completely satisfactory. The parents refused to allow further surgical procedures. One was not improved. This was a patient with pronounced spina bifida with a very thin delicate valve. The removal of the valve gave no benefit.

The results following the removal of the obstruction through the urethra in children by means of the punch have been the most gratifying I have ever had in surgery. The end-results have been exceedingly satisfactory, invalid children have been restored to excellent health by a simple procedure with practically no complications or untoward effects and with no mortality.



Fig 2 C t a c t r f b l a d d e k R g g t a n p  
t s i t h m l e d d u a t t d i t t y l e d f t e  
i u b p e t n

There have been several cases so striking in the  
eries that they are worthy of special mention

CASE 1 V y g e a s f a g h a d h d m i n g c e l  
m d h a b a b y T h l l r e l t a l l n t b u t h e  
l d b e c o n t t l l f h s i f n d h d m b b r  
l N u m u s l g t h o m b f n o l y l l e d n  
h b h l f x p s e e d t h p n t a t t h b l d  
t d u e t l y t t h e l n W h e n I  
m u n e d t h h l d h h a d a t y p l s b l d t h t  
i s a m k e d l y l e d n t l p h t h h a l l w e d  
b l t y f t h h l p t r t h a l l e c d s  
t d l t G l s e c y t s e p c t u d y I b  
s e d t m l l l r l d r u g f m t h t r t  
f e o f t h l a d d t t h g n f t h r u m  
t n u m T h w e s e c t d t h l p t b y t h  
b b y p u h T h c h i l d m u n e d l y b e g o d n g b u t  
t a m d t h a m t h d d s e d d h r n l h  
r y f t p e f t d h m d s o f t h  
33 I h a e l l d h m  
C a s A g l f o h a d j o o b t m t r s d u a l  
m k d g u h t t i d i t t y f t h r s d  
l i t a t h n l p e l I h d h d t h p t n t  
t m b f y a r s d h i d t h t n k b e r s  
t f t h r e c o p t t f t h e t l l T h  
h l d a p u t h w g g t n p t h t r s f i



Fig 3 C t c t r e f c a l c k h g h d s l n e e  
g g t a t d i t t f u t m r k d i n f e c t n d  
m a C o m p l t c u t t t f i c t l l i  
g u t r y p u c h p a t n

m l d d t t n o f t h e b l a d d e S h h d u f f e d t h  
h r o n i c p y l n p h t s u c c f y n d w e t u r l y  
W p f r l i g h t b e r s  
C r s G l f s s e s t h 6 0 0 b e n t m t r d  
l h d t m d u s d i a t t f t h t d n l  
p l a n d m l d m a S h h d u f f d w t h n d h d  
b e a t t e d f h n e p y l p h t s a c e f y S h  
h h t e l y l l f s s e f i l l g t h r m o l l  
h t e c t n f t f m t h m d p o u l c l  
e c k n t c t ( F g )

CASE 4 A b o y f 4 y a r s o f g w h b r d  
l g t h l t y a h d u f f e d w t h p y l t  
f a n y n d h d b t r t d c t a l l y b y q l i t e d p e d i  
t c i a n s l l w d p t l y e m i c c a r y n g a t g e n  
t e n t a f o T h e w a d t y r d l e e f s s  
c h e n t m t H r q u a d p l u m r y c a t t d n  
g f 3 m o t h C y t o c p m t s h o w d t h  
l y l c a l a n t n t c t f t h e a l e c k A  
3 y t g m l d t m d s b l d l b o t h r t r  
c g r g t a t d m t h n u n c h d i a m t T h a l  
p l w t m d s T h t g g m f t h c m  
p l t y l l i e d b l d r t s d k i d s p t c a l l y  
e r d t h t r a l d o m W t h 4 h u s a f t r t h e  
m l f t h h t r u t a b y m e f t h p l t h c h i l  
d d 8 4 c h e h h a d p l y n e r d d  
2 s t a i m W t h m t h t h r n p

fectly clear, and the bladder was emptying completely. He has gained 6 pounds in weight and is entirely well (Fig. 3).

CASE 5. A girl, 26 months old, had been a subject of recurrent febrile attacks for many months. Pus and bacilli had been found in the urine constantly, but there were no bladder symptoms. She had been examined elsewhere and a double ureter and renal pelvis was found on the right side with infection in the upper pelvis. Heminephrectomy had been advised. My examination revealed an obstruction at the orifice of the bladder due to valves, retaining 3 ounces of residual urine. The orifice of the ureter, which drained the infected portion of the kidney, was regurgitant. Following the removal of the valvular obstruction at the bladder neck with the baby punch, the residual urine disappeared, and with it the infection in the kidney pelvis.

This case shows the absolute necessity of observing the nature of the vesical orifice, of determining the residual urine, and of making a cystogram.

After the relief of obstruction and free drainage afforded through normal bladder emptying, the ureters will usually empty themselves completely. In some instances repeated ureteral catheterizations are required to applicate the pelvis and ureters topically and to hasten resolution. I have never seen a case in which emptying was not sufficient, in spite of the large tortuous ureters, to insure relief of absorption. Periureteritis with fixed angulations seldom occurs in infants and children. With the proper relief of obstruction from below,

absorption of periureteral inflammatory reaction will usually result as the infection recedes, and I see no indication for the extensive ureteral plastic operations such as freeing both ureters, straightening out angulations and resecting several inches of the duct requiring anastomosis. This operation is extensive and serious and misses the point entirely. It is designed to treat the effect and not the cause, and hence should have no place in this class of case.

This series of cases of bladder neck obstruction treated by transurethral removal is, as far as I can determine, the only one so far reported. I urge the profession to suspect such mechanical causes for the majority of persistent or recurrent cases of pyelitis in infants and children and to seek early investigation for such cases so that prompt corrective measures may be applied.

I can sincerely recommend the cautery punch operation for the removal of the obstructions at the bladder neck in infants and children. The procedure is delicate but strikingly simple. It has been entirely free from complications such as hemorrhage and reactions. There has been no mortality and the results have been immediate, durable, and most gratifying. This method of treatment should entirely supplant any major surgical procedure.

# INFRA-RED PHOTOGRAPHIC STUDY OF THE CHANGING PATTERNS OF THE SUPERFICIAL VEINS IN A CASE OF HUMAN PREGNANCY

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SINCE the advent of infra red photography the superficial vascular system in the living is becoming an interesting field of study.

The sole objective of this paper is to present to the clinician an infra red photographic method for the visualization of the superficial blood vessels in the living. This method may be used in the study of the normal and abnormal superficial blood vessels by any clinician who has available the ordinary photographic equipment. The only additions necessary are Eastman's infra red plates type 1R and the infra red filter.

This method which has been in use here since 1933 has proved useful in the study of the following clinical conditions: varicose veins, superficial tumors, and thrombosis of superficial and deep vessels with subsequent changes in the superficial collateral circulation. In other words it is of value in any condition that affects the superficial circulation in which heretofore the opacity of the

skin prevented the making of clear photographic records.

## PHOTOGRAPHIC MATERIALS AND METHODS

Photographic materials, method, and various applications of infra red photography are discussed in previous publications.

The infra red photographs shown in Figures 2 to 8 were made with Eastman infra red plates type 1R. Any ordinary camera may be used; it is merely necessary to place over the lens a Wratten No. 25 filter and focus the image visually with this filter in place.

The most convenient source of illumination is the incandescent tungsten filament lamp. Other sources are sunlight and arc light. In Figures 2 to 8 two 500 w. tungsten lamps were placed at an angle of about 45 degrees and about 36 inches away from the patient. It is important that all

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Fig 3 Infra red photograph of the same case at 3½ months. All of the conditions and factors in the photographic technique are the same as in Figure 2.



Fig 4 Infra red photograph of the same case at 5 months. All of the conditions and factors in the photographic technique are the same as in Figure 2.



Fig 5 Infra red photograph of the same case, 2 days before delivery (same photographic technique).



Fig 6 Lateral aspect of same stage with all conditions and factors remaining the same as in Figure 5.

# INFRA-RED PHOTOCGRAPHIC STUDY OF THE CHANGING PATTERN OF THE SUPERFICIAL VEINS IN A CASE OF HUMAN PREGNANCY

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SINCE the advent of infra red photography the superficial vascular system in the living is becoming an interesting field of study.

The sole objective of this paper is to present to the clinician an infra red photographic method for the visualization of the superficial blood vessels in the living. This method may be used in the study of the normal and abnormal superficial blood vessels by any clinician who has available the ordinary photographic equipment. The only additions necessary are Eastman's infra red plates type 1R and the infra red filter.

This method which has been in use here since 1933 has proved useful in the study of the following clinical conditions: varicose veins, superficial tumors and thrombosis of superficial and deep vessels with subsequent changes in the superficial collateral circulation. In other words it is of value in any condition that affects the superficial circulation in which heretofore the opacity of the

skin prevented the making of clear photographic records.

## PHOTOGRAPHIC MATERIALS AND METHOD

Photographic material, methods and various applications of infra red photography are discussed in previous publications.<sup>1</sup>

The infra red photographs shown in Figures 2 to 8 were made with Eastman infra red plates type 1R. Any ordinary camera may be used; it is merely necessary to place over the lens a Wratten No. 25 filter and focus the image visually with this filter in place.

The most convenient source of illumination is the incandescent tungsten filament lamp. Other sources are sunlight and arc light. In Figures 1 to 8 two 500 w. tungsten lamps were placed at an angle of about 45 degrees and about 36 inches away from the patient. It is important at all

times to use



Fig. 1. Anterior view of the patient. The image is very dark, with the skin appearing almost black, and the underlying vascular structures are barely visible as faint, light-colored lines.

Fig. 2. Infra-red photograph of the same patient. The image is much brighter, revealing the superficial vascular system as a network of dark, branching lines against a lighter background.

it will be seen that the superficial vessels have again resumed their normal appearance

record of any progressive or regressive change in these patterns

#### CONCLUSIONS

Infra-red photography demonstrates the variable patterns in the superficial vascular system in the living and furnishes a permanent photographic

#### REFERENCES

- 1 MASSOPUST L C Infra red clinical photography Radiography and Clinical Photography 1934, 10 2-6
- 2 Idem Infra red photography in anatomy Some experimental observations Annl Rec, 1934, 61 71-79

## THE SURGICAL TREATMENT OF ACUTE PANCREATITIS

DR D. DEKLIMKÓ, BUDAPEST, HUNGARY

From the II Surgical Clinic of the Royal Hungarian Pazmany Peter University, Professor Dr L. Bakay Director

A STUDY has been made of the cases of pancreatic disease treated at the Second Surgical Clinic during the past 8 years. During this time 19 cases of pancreatitis were observed, a high number considering the rarity of this disease.

There were 13 women and 6 men—68.4 per cent and 31.6 per cent, respectively. These figures confirm the general experience that pancreatitis is an illness which affects women principally. Schmieden's statistics show 64.9 per cent women and 34.4 per cent men. It is well known that cholelithiasis is a very important factor in the etiology of pancreatitis, if the ratio mentioned is compared with that of our 1200 cases of biliary calculus in which the patients were operated upon during the last 8 years, it is found that the number of women was distinctly greater. Although the number of cholelithiasis cases in our clinic shows a tendency to increase, we were not able to find an increase in the number of pancreatitis cases, as reported by several authors (Lotheissen, Haberer). We believe that single irregularities in percentages are a matter of chance. In 1934, 8 of the 19 cases were observed.

As to age incidence the average age for women was 50 years while that for men was 46 years—the youngest was 29 years, the oldest 70. In the cholelithiasis cases we find that the greater number of patients were of advanced age.

Sixty-five per cent of the patients were fat and corpulent. Schmieden's statistics show the proportion between fat and asthenic persons as 79.4 to 17.5. Three patients showed very distinct symptoms of arteriosclerosis. An additional predisposing factor was the presence of biliary calculus, in 13 cases, or 68.4 per cent, stones could be demonstrated. Schmieden reports biliary stone occurring in 69.8 to 81 per cent. Reviewing the operation and autopsy protocols, we found that in

2 cases stones could be traced in the dilated choledochus and in 2 others only a very widened choledochus was found. In each of the cases it was possible that a calculus temporarily obstructed the papilla, that is, that stasis of bile was produced. This seemed possible since the anamnestic data noted the presence of icterus. The activation of the ferments in the pancreatic duct can be explained in this way. We should not fail to mention that according to the results of Hofhauser in our clinic the common action of bile and pancreatic secretion does not produce necrosis in all cases. Hofhauser used dogs in his experiments, implanting the duct of the functioning pancreas into the fundus of the gall bladder, in spite of this he observed no signs of necrosis. It would seem to be true that stasis of bile does play rather an important rôle among the not well understood factors which cause acute pancreatitis. In one of our cases both the common bile duct and the duct of Wirsung terminated commonly in the papilla, and in addition the gall bladder was full of stones, so that there was a possibility that either bile or duodenal juice penetrated into the pancreatic duct. This finding occurs, according to the data of the literature, in 20 per cent of the cases. We observed in 2 cases a wide duct of Wirsung and in 1 of them the duct was of a greenish color due to the bile. In the cases enumerated, besides the biliary calculus, there was the anatomical possibility, that the changes due to the two secretions into the duct predisposed to a pancreatic necrosis.

In 3 cases no pathological change could be found either in the biliary vessels or in the gall bladder itself. It is a fact that cholelithiasis cannot always be found in all cases—according to Mayo it was noted in only 81 per cent and to Riese in 60 per cent—and it is possible that there is a stasis of bile without anatomical changes.



Fig 7 Infra red photograph of the same patient as in Figure 6. The photograph was taken with the diaphragm set at focus 27.

times to strive for a flat illumination of the patient for in general the gradation of the infra red plate is so fine that very delicate shades of intensity are clearly rendered. This illumination is sufficient to obtain a properly exposed negative in about 5 seconds with the diaphragm set at focus 27.

Movement and breathing should always be controlled by a method most suitable for the part being photographed. It should be kept in mind also that in infra red photography profuse growths of hair on the extremities, thorax and abdomen will obscure practically all of the underlying skin surface. When present removal of hair will aid in obtaining a clear photograph.

Plates should be handled and developed in total darkness. Many of the older type plate holder slides are somewhat transparent to infra red rays and hence when used with the infra red plate will cause fogging. The hard rubber plate holder slides manufactured by the Eastman Kodak Co. bearing five dots on the metal top of the slides are quite safe. Eastman X-ray developer (Formula D 19) was used. The average time of development was 3 1/2 minutes with the solution at 65 de



Fig 8 Infra red photograph of the same patient as in Figure 7. The photograph was taken with the diaphragm set at focus 27.

grees F. It is advisable to agitate the solution continually to prevent streaking.

The case illustrated in Figures 1 to 6 which was observed for a period of 7 months and photographed at interval and which proved to be a normal pregnancy in every respect demonstrates the gradual change in the photographic pattern of the superficial veins in the breast and abdomen during normal pregnancy. The gradual changes in the conspicuousness of the superficial veins in the breasts indicate that a gradual preparation for lactation is taking place which reaches its maximum directly after delivery when the mammary glands are actively functioning. With further observations and study this method may reveal the future capacity of the breasts to function adequately in the production of breast milk.

That there is an increase in the size and conspicuousness of the superficial vessels in the breasts and abdomen during pregnancy is an established fact. Infra red photography however has made it possible to record these vascular changes as they occur thereby furnishing a permanent photographic record for comparison during the progression of the pregnancy. The appearance of the same patient 11 months after delivery is illustrated in Figures 7 and 8 in which



especially from the standpoint of treatment. X-ray examination was found of great value in detecting the results of acute pancreatitis, for instance, in 1 case we diagnosed a pseudocyst of the pancreas, in another a retroperitoneal cyst.

Summarizing the results, it can be stated that of 19 cases only 4 were definitely recognized as pancreatitis and 2 were diagnosed as probable pancreatitis. Six of our patients were in such poor condition that we decided against even exploratory laparotomy, although very serious abdominal complaints were noted.

Acute pancreatitis is certainly a very serious illness. Of our 19 patients 11 died, making the mortality 58 per cent. Two patients were not operated upon because of their serious condition, both died very early. The mortality therefore of the 17 patients operated upon is 53 per cent.

From the standpoint of clinical symptoms and the operative and autopsy findings, our cases varied greatly, therefore, it seems advisable to divide the cases into three groups on the basis of their clinical symptoms, that is according to the pathologico-anatomical changes.

I Very serious cases with extremely sudden onset, rapid progress, and usually an unfavorable outcome. In these cases the autopsy shows widespread fat and pancreatic necrosis, colliquation, abscess, hemorrhage.

II Semiserious cases with acute onset and a tendency to subside. In these the autopsy reveals edema with less extensive fat necrosis, smaller sequestration, circumscribed abscess, and in farther advanced cases pseudocysts.

III Mild cases with acute onset which ordinarily subside. Autopsy reveals edema with fat necrosis.

It should be mentioned that we do not regard isolated edema without fat necrosis as pancreatitis, we consider it just the preliminary stage. Fat necrosis was observed in every case.

In the first group there were 6 cases, in the second 9, in the third 2 cases, a total of 17 cases.

Seventeen patients were operated upon, 9 immediately, 8 others after an interval of 20 days and only after the clinical and chemical examinations were made. Of the 9 patients immediately operated upon, 6 were in group I and 3 in group II.

In general, those in very serious condition and some in less serious condition were operated upon immediately, in 2 cases the diagnosis of pancreatitis was definite, in 1 case it was only probable. The 6 others were operated upon for peritonitis and ileus.

After a period of waiting 8 patients were operated upon, 6 cases in group II and 2 cases in

group III. Thus in some of the less serious cases and in some of the mild cases operation was delayed so that the acute stage of pancreatitis was observed in the clinic. After administering drugs to raise the blood pressure and infusion, all the patients recovered from shock and collapse, even the patient who died later and who had been operated upon 8 days after the onset to drain an abscess. In 2 serious cases pancreatitis had been diagnosed when the patients were admitted to the clinic. In 1 a cyst formed during the interval of waiting and was subsequently operated upon. In the other patient the symptoms of biliary calculus were clinically observed and at operation an inflamed gall bladder without stones, edema, and fat necrosis was noted. In 1 case the diagnosis was probable pancreatitis, and when the gall bladder and stones were removed, a circumscribed fat necrosis and a marked edema were observed around the pancreas. In 2 cases pancreatic cysts were operated upon, although they could not be diagnosed when the patients were admitted to the clinic. One of our patients was in very bad condition and had stenosis of the pylorus as revealed by X-ray examination. At operation marked edema, fat necrosis, and a distinct constriction of the pylorus were noted. In 2 mild cases our diagnosis was extragastric tumor, cholelithiasis, in both of them subsiding pancreatitis could be observed.

#### Therapeutic results after immediate operation

	Cases	Deaths	Recoveries	Mortality per cent
Group I	6	6	0	100
Group II	3	2	1	66

#### Therapeutic results of the operation after delayed treatment

	Cases	Deaths	Recoveries	Mortality per cent
Group II	6	1	5	17
Group III	2	0	2	0

We are quite aware of the fact that the number of our cases is small. It must be admitted, however, that the results after immediate and delayed operation show a remarkable difference.

In group I, patients operated upon immediately did not survive the trauma of operation. It should be stated that many types of operations and kinds of anesthesia predispose in certain patients to shock and collapse and we do believe that it should not be stated that operation cures the collapse or that the presence of shock does not

which is based on the dyskinesia of biliary vessels (Stocker Walzel Lang) If in addition to the pathogenetic factors mentioned—disturbance of the blood supply biliary stasis penetration of the bile and duodenal juice into the pancreatic duct—infections of the hepatic system are considered then nearly all conditions which may cause acute pancreatic necrosis—have been given Infection takes place upward along the lumen or through the wall of the pancreatic duct or downward by means of the lymphatic system Infection was probably present in 4 of our cases

In 3 cases neither the operation nor the autopsy revealed any special explanation for the actual state of the gall bladder especially regarding the biliary vessels

It is a well known fact that the duodenum the biliary vessels and the pancreatic system are very closely connected with each other therefore any changes in one produce a very distinct effect upon the others For this reason the primary focus of a single disease is still open to much discussion and the prompt localization of the point of origin is indeed a difficult problem It can reasonably be stated that in diseases and functional disturbances of the hepatic system the pancreas plays the rôle rather of the victim—pancreatitis—than of an intermediary

Two cases of pancreatitis are not reported with the 19 others because of their special pathogenesis In one a tumor the size of an almond was extirpated from the papilla of Vater through the transduodenal route—carcinoma adenoides The patient died after the operation from necrosis of the pancreas Although the autopsy revealed the conditions causing pancreatitis—a wide cholecystochus a wide duct of Wirsung marked biliary stasis the result of obstruction produced by the tumor—it is true that the extensive necrosis might have been caused by trauma incident to the operation In the second case a deep callous ulcer was extirpated according to the Billroth II method with partial resection of the head of the pancreas A circumscribed necrosis of the head of the pancreas followed operation

These so called postoperative pancreatitis cases—Schmieden collected 14, of them—affirm the experience that from the operative viewpoint the pancreas can be considered a very sensitive organ Finsterer performed partial resection of the pancreas in 71 cases of carcinoma of the stomach 23 of the patients died following the operation and in 9 he ascribed the lethal outcome to injury to the pancreas

Regarding the diagnosis of acute pancreatitis it can be stated that there are no symptoms ab-

solutely peculiar to this disease We recommend the acceptance of the advice of Koerte that disease of the pancreas should not be overlooked in any case of serious abdominal disease Very often the disease cannot be diagnosed with its classical symptomatology still it can be differentiated from other acute diseases which resemble pancreatitis and the treatment of which is nowadays generally known and accepted As to the value of chemical tests to determine pancreatic function opinions differ greatly—Guleke Unger Heuss Roepke Redwitz Reuter Koch Bernhard Mackenzie etc It is true that in addition to the clinical symptoms careful examination of pancreatic function is of great value Determinations should be made of the diastase content of the blood urine and duodenal juice the lipase content of the blood and the sugar tolerance In some cases however the patient's pulse is barely perceptible and the surgeon has no opportunity to make all these tests even though he has at his disposal a perfectly equipped laboratory and the necessary assistants If only one of the mentioned tests is selected to be done and the test is one which is quickly done and which does not strongly affect the patient it should be stated that no one of them has pathognostic value on the basis of experiments which were performed in our clinic by Kuraly even a strongly positive Wohlgemuth test of the urine has no practical value

We value the leucocyte count highly In most cases the leucocytes are distinctly increased in number—12 000 to 20 000 The count must be made quite frequently especially in the cases when delay is necessary In our experience the sudden increase in leucocytes up to hyperleucocytosis—32 000 to 35 000—indicates a bad prognosis on the other hand diminution indicates rather that the process is calming down

In our cases the urine never contained sugar We did find albumin frequently several times bilirubin and urobilinogen The prognosis is very bad if the urine is concentrated and the quantity diminishes so that finally there is total anuria In one of our unfavorable cases which progressed rapidly and in which a diagnosis of uremia was made we found at autopsy among other changes parenchymatous degeneration of both kidneys caused probably by toxic action and a widespread fat necrosis of the fatty capsule of the left kidney Sobn has published a similar case

X ray examination is important first of all from the standpoint of differential diagnosis Although we were never able to diagnose acute pancreatitis with the X ray nevertheless many diseases could be ruled out by means of it and this was of value

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Summarizing the results, it can be stated that of 19 cases only 4 were definitely recognized as pancreatitis and 2 were diagnosed as probable pancreatitis. Six of our patients were in such poor condition that we decided against even exploratory laparotomy, although very serious abdominal complaints were noted

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We are quite aware of the fact that the number of our cases is small. It must be admitted, however, that the results after immediate and delayed operation show a remarkable difference

In group I, patients operated upon immediately did not survive the trauma of operation. It should be stated that many types of operations and kinds of anesthesia predispose in certain patients to shock and collapse and we do believe that it should not be stated that operation cures the collapse or that the presence of shock does not

contra indicate immediate operation. It is very important in acute pancreatitis that the patient come safely through the period of collapse or shock to secure the best operative result. For this purpose we have numerous means at our disposal which act rapidly and which can be used successfully. All our patients were thus treated before operation.

In group II only 1 patient survived a mortality of 66 per cent.

Our statistics show that immediate operation was done in the serious and less serious but not moribund cases. But since all the patients except 1 died it can be stated that operation was of no special advantage. Although pancreatitis is quite a serious illness it may be supposed that by defaying operation spontaneous recovery may take place and thus an improvement will be brought about in our statistics. Our immediate operative procedures were based upon the uncertainty of the diagnosis.

In the less serious cases operated upon after delay—group II—the mortality was 17 per cent in contrast with the mortality of 66 per cent in the immediate operation group. This striking difference and the zero mortality in the mild cases belonging to group III obviously prove that delayed operation is by all means advisable and correct. If after the acute stage an abscess or a cyst is formed there is still plenty of time to operate upon the well prepared patient who will be in much better condition after treatment for the initial shock. The patient who died after the abscess was opened demonstrates that pancreatitis is a very serious illness and that during operation isolation of the free abdominal cavity does not always succeed.

We mention briefly that in 3 cases of the emergency operation group the gall bladder was removed in the other cases only the usual opening was made with tamponade and drainage. In all patients operated upon after waiting cholecystectomy was done that is the pseudocyst was opened—in 1 case an abscess of the pancreas. The pancreas itself was never operated upon.

In recent years there have developed two different viewpoints regarding the treatment of acute pancreatitis. The advocates of immediate operation—Guleke, Schmieden, Sebening, Arnsperger, Koenig, Roepke, Bruening, Doberauer, Kappis, Martens, Roseno, Brocq and the French authors—are opposed by those who favor the expectant treatment—Nordmann, Walzel, Pólya, Mikkelson, Reschke, Fischer and an ever increasing number of American surgeons. While the number of cases and observations of the latter group is

small the results have been unexpectedly good and we believe that eventually the delayed surgical treatment will be generally accepted.

Detailed statistics which show the result of immediate operation are available (Guleke, Schmieden, Brocq). We concur with Walzel that in acute pancreatic disease the pathologico-anatomical changes are very variable further that the patient's reactions both as to the disease and to immediate operation are so different that the conclusions drawn may be wrong and the interpretation of the results of problematic value—in many cases operation is performed without a detailed examination, preparation of the patient and a correct diagnosis.

The fact that contrary opinions have arisen can be explained by the fact that the operative results are very bad. We believe that early operative treatment did not yield improved results as is shown by both the earlier and more recent statistics. In Koerte's cases, 1911, the mortality was 60 per cent while it diminished to 52.2 per cent in the cases of Guleke, 1924 and to 51.2 per cent for those of Schmieden, 1927. From this standpoint it is especially interesting to study the results of the operative procedure of the French surgeons described in the collected works of Brocq. The death of 78 patients with acute hemorrhagic pancreatitis operated upon before 1910 means a mortality of 67.9 per cent while in 160 cases after 1910 the mortality was 58.7 per cent. Brocq ascribes this considerable drop of 9 per cent to the fact that the procedure included not only operation upon the pancreas but upon the biliary tract—excision with drainage of the choledochus etc. It may be stated from both the earlier and later statistics that in this sort of work an error of 8 to 10 per cent may easily arise therefore no reliable conclusions can be drawn. Also it should be stated that since 1910 improvements have been made in the preliminary measures in the anesthesia and in asepsis all of which tend to produce better operative results. This fact is not quite clearly brought out in the statistics. If immediate operation is really the method of choice in the treatment of pancreatitis there will be improvement in the late end results as is so easily seen when early operation is done in the case of peptic ulcer when it perforates into the free abdominal cavity.

The fact that the majority of patients not operated upon—that is 95 per cent—die does not support in any way the theory that immediate operation is the correct procedure in our own clinic 2 moribund patients not operated upon died. We believe that some patients not operated upon

die simply because pancreatitis is a serious illness and that no sort of immediate operation could have saved them. We believe that this should be emphasized, for we fail to find in the statistics reasons for the advocates of immediate operation not performing operation in the non-operated upon cases. We are quite sure that the statistics which show a high mortality percentage include a great many moribund patients.

Experience shows that spontaneous recovery at times occurs in cases of pancreatitis. When performing laparotomies, especially in cases after cholecystectomy, we often have found encapsulated areas of fat necrosis on the omentum, the mesentery, and around the pancreas, traces of previous pancreatitis affections. Otherwise the course of the disease is very variable, in clinically helpless cases the patients often make great progress. We observed this fact in the majority of our patients who were operated upon after due observation. If the operation is done immediately it is impossible for such improvement to occur and the surgeon then is inclined to consider the favorable outcome in the mild case as due to the operation.

The statistics of Brocq show how the results of treatment of pancreatitis vary even if operation is performed. In his 50 cases with operation and simple drainage before 1910 the mortality percentage was 58, while in the 112 cases with drainage after 1910 the percentage mortality was 65. This percentage is no doubt distinctly better than that for the cases without operation—the latter show a mortality percentage of 95. However, the favorable results cannot be attributed to the operation alone because it is a generally accepted fact that exploratory laparotomy with drainage is of practically no therapeutic importance (Hahn). We believe that in Brocq's cases only the patients fit for the operation, not moribund patients, were considered, that the minor operative procedure he used did not affect the possibility of spontaneous recovery.

According to Schmieden the result of operation depends on the degree of pathological change in the pancreas. His statistics can be appreciated especially by the surgeons who advocate waiting but the figures are of less interest to the surgeon who favors immediate operation. According to Schmieden the mortality is 23 per cent when operation is done while the pancreatitis is in the edema stage and no fat necrosis is yet present. The edema is considered by many authors to be the initial stage of the pancreatitis, fat necrosis can be seen after 16 hours. We believe that isolated edema does not always indicate the

presence of pancreatitis, very frequently in cases of severe gastritis or cholecystitis edema is noted as a secondary change. Therefore, we believe that in patients who were operated upon in this stage and who recovered—77 per cent—no pancreatitis would have developed and that the high mortality percentage is due rather to the operation itself and to the injury thus produced upon the pancreas. In the initial stage of pancreatitis certain symptoms are inevitable: necrosis or hemorrhage, or both together (Walzel). The mortality rate of immediate operation in this stage is 60 per cent, this percentage is only a little better than that for the cases which show the severest changes, necrosis and liquefaction—68 per cent. The latter mortality rate demonstrates the uselessness of operation.

After observation we operated upon only a few cases in the stage of edema and the mortality was zero. Likewise in the less serious cases of somewhat advanced stage the mortality was only 17 per cent. If statistics could be made in a large series of cases in a similar stage, it would be of great help in determining the value of treatment when operation is not done immediately. In the few cases recorded in the literature the results are quite similar to those of our clinic.

#### TECHNIQUE

In acute pancreatitis the operation consists of the following steps: opening, tamponade, and drainage. The same technique is adopted if the disease is either of infectious or autodigestive origin. Although the technique of operation is based upon the rules for septic cases, it is used in case of fermentative injury too. We believe that this accounts for many of the unsuccessful operations. Besides the operation upon the pancreas, auxiliary operations are performed on the biliary tract. The aim of the latter is to relieve the pancreas, to drain the choledochus, and to use other means in an effort to check the flow of bile. All these proceedings, however, do not materially alter the end-results.

Although we realize that a series of 19 cases is a small number on which to make definite conclusions, we do think that the results of expectant method as practiced in our clinic are worthy of publication.

#### SUMMARY

We try to overcome both shock and collapse by means of normal salt infusion, and intravenous glucose injection, and by administering camphor, caffeine, cardiazol, sympathol.

We try to confirm our diagnosis by means of X-ray examination, by determination of the

leucocyte count by the Wohlgemuth test of the urine and by an exact clinical study

If the cause of the serious abdominal symptoms cannot be detected or it is not possible to differentiate the conditions from other diseases which would necessitate immediate operation after having carried out the preliminary measures just mentioned we perform using local anesthesia an exploratory laparotomy the incision lying along the anterior iliac spine the Sonnenburg line. This minor procedure is quite sufficient to enlighten us as to the point of origin of the disease. If we find that the condition is not the result of perforation of the stomach duodenum intestine appendix gall bladder—if it is not the result of ileus or some acute gynecological change we search no further. If we find a pancreatitis associated with severe hemorrhage even though we are quite conscious of the fact that in most cases operation is nearly always hopeless a general anesthetic is administered and an attempt is made to stop the hemorrhage.

If acute pancreatitis has been diagnosed or if the condition has been differentiated from other diseases which necessitate immediate intervention the patient is kept under observation. The blood count is made often and urotropine is administered in large doses. If during the clinical course anemic symptoms arise further if suppuration that is an abscess or a cyst forms surgical intervention is immediately carried out. If the condition is inclined to subside the patients are carefully examined after 20 to 25 days. In this interval it can be definitely determined as to whether the biliary system is affected. In most of the cases cholecystectomy is performed. If there is a calculus in the choledochus it is drained out. The gall bladder without stones but usually inflamed is routinely extirpated. This operation is of prophylactic importance too because in our experience we have found that acute pancreatitis does not develop after the gall bladder is removed except in cases of postoperative pancreatitis from injury. If the state of the patient becomes worse in most cases a fulminating pancreatitis is present and the disease progresses quickly to fatal termination before operative procedure can be successfully performed.

According to the principles described we expect a future improvement in our statistics.

Of the 8 patients who survived the acute illness 6 afterward were controlled and examined in our clinic. The examination has been performed 6 months and 1 year after the operation in 1 case even after 5 years. We place special emphasis on this examination because it is a fact that after

acute inflammation that is after the fermentative injury disturbances in internal secretion may arise in the pancreas. One patient of Koerte died in diabetic coma 8 years after the operation. Schmieden states that in 18 cases diabetes subsequently developed and that 3 patients died in diabetic coma.

In all of our patients—5 semi serious and 1 mild—the pancreatic function has been fully examined. The external secretion of the pancreas was investigated by determining the diastase in the blood the urine and the duodenal juice and by examination of feces. The internal secretion of the pancreas was investigated by performing a sugar tolerance test.

In our experiments upon the external secretion we found that the diastase content of blood and urine varied within normal limits. In 2 cases we found a higher concentration in the duodenal juice above 1000 while in other cases nothing of this sort could be registered. The macroscopical and microscopical examinations of the feces as well as digestion tests showed no pathological changes. It may be concluded therefore that in our cases the external secretion of the pancreas was not permanently disturbed by the acute illness.

The result of the sugar tolerance determinations which indicate the function of the internal secretion are summarized in Figure 1.

It is quite evident that the blood sugar concentration differs from the normal by elevation to higher values during the first 30 minute above 180 milligrams per cent. The curves 6 5 3 rise even to 200 to 210 milligrams per cent. After 1 hour the curve falls but it does not reach the low concentration of the control patient. The concentration is higher than 120 milligrams per cent and after 1 1/2 hours when the blood sugar of the control patient is quite normal 100 milligrams per cent the sugar concentration of the examined persons is still higher. The greatest differences are shown by the curve 6. The curves 1 4 do not differ much from the normal during the first 30 minutes but they attain their deepest point later. It was only in the presence of the three highest curves that we found glycosuria during the experiments and this ceased after 2 hours.

It was our aim to discover a parallel relation between the changes in the blood sugar curve and the gravity of the acute pancreatitis. We found that the most intense change was in the patient who had the mildest case of pancreatitis. This is quite similar to the findings of Tammann who believes that the disturbances of internal secretion are not in direct ratio with the gravity of the changes found at operation and with the

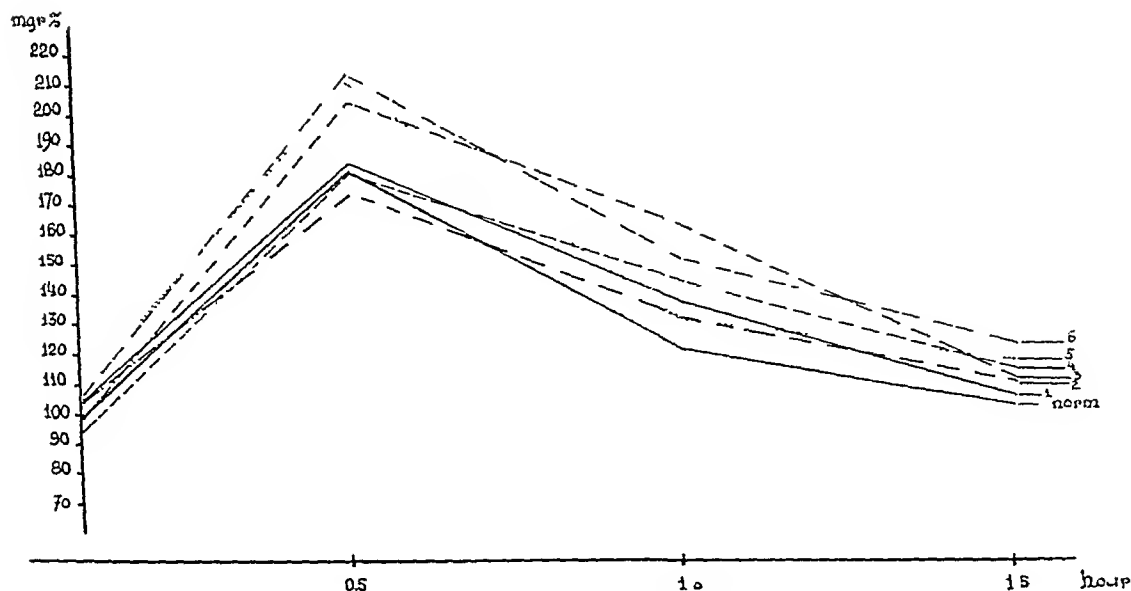


Fig. 1 Sugar tolerance determinations

length of time which has passed since operation. We did note definitely a certain change in the pancreatic function—internal secretion—which causes us to keep track of our patients. However, the absolute lack of any sort of complaint confirms our belief that after the relief of the acute

illness restoration not only macroscopically and microscopically is secured, but even functionally an approximate *restitutio ad integrum* can be shown and only very seldom do late complications, for instance pancreatic diabetes, endanger the patient's life.

## GASTROJEJUNOSTOMY PRE-OPERATIVE DECOMPRESSION

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**G**ASTROJEJUNOSTOMY is employed most commonly for the relief of organic obstruction at the pylorus. If the obstruction is one that develops slowly, it often leads to an increase in size and capacity of the stomach. The stomach walls become thickened in the more muscular portions and dilated in the less muscular portions. Associated with this hypertrophy and dilatation there is usually some edema. Drainage of the stomach by gastrojejunostomy or continuous aspiration is followed by a decrease in length of the muscle fibers of the stomach. This results in a diminution in size and capacity of the stomach. Associated with this there results an improvement of the circulation in the blood vessels and the lymphatics and a disappearance of the static edema from the walls of the viscus.

This decrease in length of the smooth muscle fibers is generally referred to as an increase in tone. Yet the intravisceral tension may be the same and the contractile power of the muscle fibers is present regardless of whether the fibers are long or short. This is evidenced by the peristaltic waves which course across the dilated stomach. This relatively fixed condition which smooth muscle manifests at different lengths without a change in intravisceral tension and in which relatively fixed condition the muscle can contract and relax rhythmically has been termed *metrostasis*. Dr. A. C. Ivy who coined the term and defined it, cites the urinary bladder as a classical example. If this viscus is distended within reasonable limits and then emptied of one half of its contents, the intravesical pressure will be approximately the same as when it was distended with twice as much fluid. This shows that the fibers manifest the same tension at the different lengths; the term *tone*, not being strictly applicable for a change in tone connotes a change in tension.

In the case of the dilated stomach, it can and usually does contract efficiently but the obstruction renders the contractions useless. Relief from the effects of the obstruction by the formation of a new outlet permits the elongated fibers to shorten in length. This results in a reduction in size of the newly formed gastrojejunostomy stoma which was made for the purpose of draining the dilated stomach.

In a previous paper we pointed out the importance of the proper size, location, and direction of

the artificial stoma in gastrojejunostomy. It is obvious in the light of our present knowledge that an operation on a dilated stomach presents many obstacles and is less likely to succeed than a similar operation on a stomach properly prepared. We believe that too little emphasis has been placed on the value of thorough pre-operative care in patients whose pyloric orifices have become gradually occluded. The walls of such dilated stomachs are often thickened and edematous. Suturing of these walls is difficult and treacherous. The contour of the viscus and the topographical relations make it difficult if not impossible to design an operation that will efficiently serve its purpose in the distended stomach and will continue to serve just as efficiently in the stomach whose size, capacity, and contour is changed following drainage.

We have adopted a method of preparation in patients with pyloric obstruction which has given us good results, and we wish to present the details of management in the hope that those who have not made use of a similar method may use or modify the present method to suit their requirements.

## METHOD EMPLOYED FOR DECOMPRESSION

At the outset the stomach is evacuated of its gross contents by a stomach pump. Thus undigested food particles which may interfere with suction are removed early. A method of continuous aspiration is then instituted. It is a combination of the methods suggested by Wangensteen, Bartlett, Babcock, Pratt and Peluse. We are convinced of its efficiency when properly selected cases are treated.

In a recent paper Bartlett uses the term *pyloric balance* to signify the ability of the stomach to empty its contents into the duodenum. He suggests that the term *negative pyloric balance* be applied when the amount of gastric contents which can be aspirated exceeds the amount which has been given by mouth. The term *positive pyloric balance* is applied when the amount of gastric contents which can be aspirated is less than the amount which has been given by mouth.

In the presence of a negative pyloric balance when the aspirated material exceeds the amount given by mouth, one may assume for practical purposes that the increment may be the result of



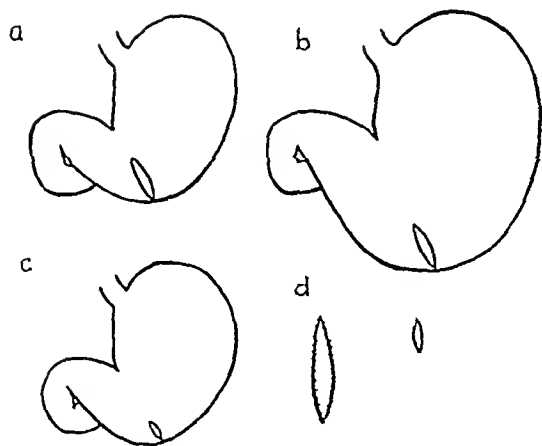


Fig 1 *a*, The comparative relationship between the stoma and stomach in a viscus of normal size *b*, The approximate relationship in a dilated stomach *c*, The relationship between the viscus and the stoma after the dilatation has been relieved by a gastrojejunostomy *d*, Adjustment of muscle fibers to new length with decrease in size of stoma due to muscle fibers acting in this new and shorter length

TABLE I—DATA FROM WHICH FIGURE 3 IS ASSEMBLED

Date 1935	Interval	Amount given by mouth	Amount aspirated	Pyloric balance	Pyloric balance per hour
3-1	1 30 a.m. - 7 00 a.m.	0	15	-75	-12.5
	7 00 a.m. - 11 00 a.m.	12	92	-80	-20
	11 00 a.m. - 3 00 p.m.	4	64	-40	-10
	3 00 p.m. - 1 30 a.m.	190	310	-120	-12
3-2	1 30 a.m. - 7 00 a.m.	60	125	-65	-9.5
	7 00 a.m. - 12 00 m.	60	90	-30	-6
	12 00 m. - 7 00 p.m.	74	110	-36	-5.1
	7 00 p.m. - 1 30 a.m.	282	325	-43	-6
3-23	1 30 a.m. - 12 30 p.m.	48	100	-52	-4.7
	12 30 p.m. - 9 30 p.m.	154	190	-36	-4
	9 30 p.m. - 10 30 a.m.	300	100	-200	+12
3-24	10 30 a.m. - 7 45 p.m.	294	350	-56	-6.2
3-25	7 45 p.m. - 6 30 a.m.	135	85	+50	+4.5

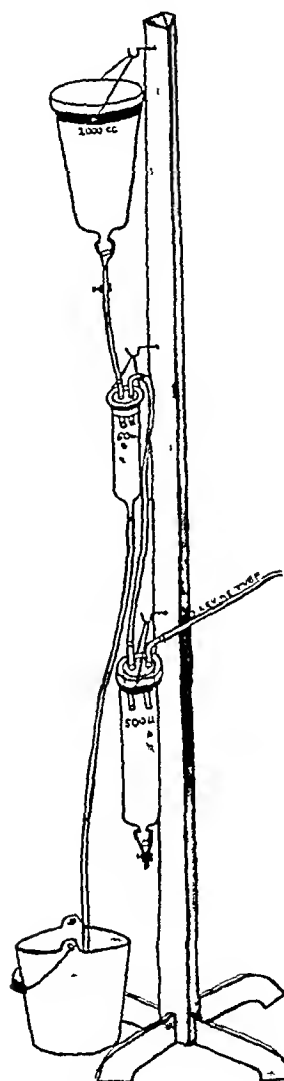


Fig 2 Diagram of set-up of suction apparatus

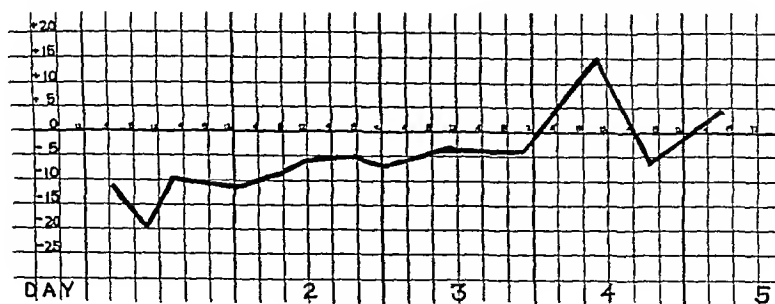


Fig 3 Pyloric balance chart

gastric secretion or duodenal reflux. In the presence of a positive pyloric balance when the aspirated material is less than the amount given by mouth it may be assumed that the stomach is able to evacuate some of its contents because absorption from the stomach is negligible.

We have adopted the use of these terms and have arranged a chart which assists in keeping an accurate record in graph form of the state of the stomach and its ability to empty itself.

The accompanying chart was made from data compiled from a case of pyloric obstruction on our service. The ordinates represent time intervals. The abscissas represent the aspirated material in cubic centimeters. If a negative pyloric balance is present it is recorded below the base line. If a positive pyloric balance is present it is recorded above the base line. Aspirations are computed on an average hourly basis since it may not be necessary or desirable to aspirate more frequently than every 4 to 6 hours.

In cases in which pyloric obstruction results from peptic ulcer one may be able to establish positive pyloric balance in a considerable number of cases by the use of the method described. Even in pyloric obstruction resulting from malignant lesions it is not uncommon to secure a positive pyloric balance by the same method. In

these cases we have also been impressed by the apparent benefit derived from the administration of 60 to 80 minims of dilute hydrochloric acid three times a day. This is usually given in about 30 cubic centimeters of the juice expressed from raw beef diluted with an equal quantity of water. In all patients with pyloric obstruction careful consideration must be given to the matter of hydration, nutrition and chemical balance. This is exceedingly important but cannot be considered within the limits of this paper.

It has seemed to us that our operations in cases of pyloric obstruction have been facilitated by adequate preparation and that the postoperative course of patients thus treated amply justifies our recommendation of the plan of pre-operative management which is described.

#### SUMMARY AND CONCLUSIONS

1. The importance of pre-operative decompression of the stomach is emphasized.
2. A method of decompression is described.
3. A means of determining the appropriate time of operation is brought out (positive pyloric balance).
4. Nutrition, hydration and chemical balance of the patient must be cared for by appropriate methods.

## OBSERVATIONS ON LYMPHOGRANULOMA VENEREUM

CLINICAL PATHOLOGICAL STUDY OF SIXTY CASES, WITH OBSERVATIONS ON THE HISTOPATHOLOGY OF THE FREI TEST<sup>1</sup>

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IN 1786 John Hunter recognized the "climatic bubo" as a clinical entity and as "different from other diseases of the inguinal glands." In 1865 the French clinician Trousseau suggested that the disease in question was of venereal origin.

He described a lymph node infection which he had observed particularly among creoles. The disease occurred especially in adolescents, and produced paroxysms of fever and swelling of the inguinal nodes which broke down. Sinuses resulted which took many months to heal.

In 1925 Wilhelm Frei introduced the specific intradermal test which now bears his name. Positive results were found not only in cases of inguinal bubo, but in various pelvic inflammatory conditions as well. Among the latter are included the following: esthiomène, anorectal syphiloma, rodent ulcer of the vulva, pudendal elephantiasis, hyperplastic infiltration of the rectum, and inflammatory stricture of the rectum. Because of the clear cut results with the Frei test, it is now possible to correlate the findings in most of the conditions mentioned and to classify them under a single head of lymphogranuloma venereum.

The infection is usually acquired venereally. The etiologic agent is probably a filtrable virus. This virus may be transmitted experimentally to a number of animal species. The onset in humans is characterized by a small initial inoculatory lesion on the genitalia. This is followed by an inflammatory swelling of the regional lymph nodes with involvement of the adjacent connective tissue and lymphatics. In the majority of cases, multiple small foci of necrosis and suppuration occur within the nodes. Constitutional symptoms appear, which include lassitude, fever, sweats, anorexia, loss of weight, transient rash, and arthralgias. The adenopathy in males generally is localized to the inguinal or inguinocruro-iliac group of glands, giving rise to an inguinal bubo. In females the localization of the infection generally takes place chiefly in the intrapelvic glands and the subsequent inflammatory and cicatricial reaction set up in the endopelvic fascia leads to the genito-ano-rectal syndrome.

This report deals with 60 cases presenting histories and clinical findings suggesting lymphogranuloma venereum. The patients presented

themselves for observation and treatment at the Mount Sinai Hospital during a period of three years. All of these patients showed a positive Frei intradermal reaction. Negative control cases tested with the same antigen were run simultaneously. Based on clinical and pathological findings, the positive cases were classified into predominantly glandular, rectal, and genital types (Table I).

The lesions among the males are preponderantly glandular, while among the females they are mainly rectal. There are, however, 8 rectal cases in male patients. It is noteworthy that about half of all the cases were in white males. The hospital population, however, is only 5 per cent negro and 6 per cent Porto Rican. This would account for the high proportion of the white group in this series.

**Glandular cases.** Inguinal glandular enlargement dominated the clinical picture in 30 cases. There were 29 men and 1 woman. Among these were 19 white men, 4 negroes, 1 negro, and 6 Porto Rican men.

The average age was 29 years, the youngest 16, and the oldest 43.

A history of an initial penile lesion was obtainable in only 12 of this group. The nature of the lesion was described as a papule, vesicle, small laceration about the corona, or a herpetiform lesion on the shaft. Four gave a history of an urethritis which was very probably specific. This is important because it may be confused with a gonorrheal infection. This urethritis differs from that of gonorrhea in that the discharge is loose, shows only leucocytes but no organisms on smear, and disappears within 3 to 4 days, spontaneously.

TABLE I—CLASSIFICATION

	Glandular		Rectal		Genital		Total
	Male	Female	Male	Female	Male	Female	
White	19	0	6	3	1	0	29
Colored	4	1	0	9	-	0	14
Porto Rican	6	0	2	5	0	2	15
Total	29	1	8	17	1	2	60

<sup>1</sup>From the Laboratories and Clinical Departments of the Mount Sinai Hospital, New York, New York.

All of the white male patients in this series gave a history of sexual contact with negroes and some could relate the onset of their disease to such a contact.

The incubation period could not be determined accurately. A time interval of between 2 and 5 days may be considered as likely.

In most of the cases the primary lesion healed spontaneously within 2 weeks after its first appearance. Secondary glandular enlargement occurred from 4 days to 3 weeks after the appearance of the initial lesion. The enlargement was unilateral in 19, bilateral in 11 cases. The 4 cases which presented a urethritis as their initial lesion had bilateral inguinal glandular involvement. The glands broke down and formed pus in 20 of the 30 cases (66 per cent) within 3 weeks after the enlargement was noted. In other words it takes 6 weeks or less from the onset for the inguinal glands to reach their maximal reaction. By that time they have either broken down or have begun to recede.

The glandular enlargement in all but one of the cases was limited to the inguinal and iliac glands. In this case which was exceptional a generalized adenopathy with abscess formation in a submental node occurred.

The Wassermann reaction was negative in all but 2 cases. One case with a two plus Kahn reaction at the onset became negative after 3 months without antiluetic treatment. The other was a known luetic. Bacteriological culture of the pus in all of the cases which had not broken through the skin spontaneously was sterile. Ziehl-Neelsen stains for tubercle bacilli were also negative.

The relation of the process in the lymphatics to the development of elephantiasis was studied. In 3 cases the inguinal glands were excised bilaterally. In still 1 other extensive suppuration with spontaneous healing occurred. The penile lesion in all these 4 cases healed completely and there was no history of reinfection even so long as 12 years later. None of these 4 developed postlental lymphedema. In 1 other case bilateral excision of the inguinal glands was followed by marked lymphedema within 6 weeks. The lymphedema however was preceded by crop of venous ulcers on the penile skin lesions which continued to appear for a number of months. After excision of the inguinal lymph nodes or their destruction by disease the drainage of lymph is through the scrotum and through the central point of the perineum into the endopelvic glands. This new course seems to form an adequate collateral circulation when no further infection is present on

the external genitalia. With a persistent focus of infection the local disease spreads also to the anastomotic lymphatics and an elephantiasis of the penis and scrotum may follow. Similarly in the female a persistent focus on the external genitalia is likely to produce a vulval elephantiasis.

Biopsy of the inguinal glands in 13 cases showed lesions in 11 which were sufficiently characteristic for histological diagnosis. The duration of the disease at the time of biopsy was usually 3 weeks to 2 months. The 2 cases that presented a picture different from the usual one were of at least 3 months duration and were both complicated by chronic persistent sinuses and a secondary infection with *Staphylococcus aureus*. These were the only 2 cases in this group in which a culture of the glands or pus removed was not sterile. This alone may be sufficient to change the pathological picture to one of chronic nonspecific adenitis. It is therefore justifiable to say that biopsies of lymph nodes not secondarily infected are quite reliable in making the diagnosis.

The problem of treatment of the glandular cases up to the present has essentially been a surgical one. Incision and drainage proved necessary and sufficient in most cases. More radical procedures such as a complete excision of the inguinal glands became an optional procedure in a minority of cases. Because of a possible later sequel such as stricture of the rectum or elephantiasis of the genitalia after complete excision it is advisable to resort to more conservative measures. In 2 cases large fluctuant abscesses had formed in the groin. These were treated by aspiration and twelve repeated injections of 0.1 cubic centimeter of Frei antigen. Although small sinuses formed at the site of puncture both of these cases subsided without any further therapy. Nine cases in all received treatment with Frei antigen in increasing doses. In 5 cases no breaking down occurred while in 2 cases in which sinuses had formed before the treatment was begun these sinuses closed promptly.

These 9 cases suggest the possible therapeutic benefit of an attempt at desensitization. It is particularly noteworthy that the pain and tenderness of the involved glands disappeared very promptly even as early as after the second injection. In spite of this the Frei reaction remained positive even after as many as 60 inoculations over a period of 2 years. This probably indicates the persistence of a focus of low grade infection even when not detectable clinically. (9)

Other forms of treatment used in our cases consisted in X-ray therapy, ultraviolet therapy,

foreign protein therapy (typhoid vaccine) and arsphenamine, all without any evidence of success

It seems advisable, therefore, to treat these patients more conservatively, to provide aspiration where it is indicated, and attempt desensitization. If this should fail, then surgical incision and excision are indicated.

The average time of disability in this series was 2 weeks in the hospital and between 2 and 7 months in the clinic for dressing. All of our group were healed by the end of 7 months.

**Rectal cases** Rectal symptoms and signs dominated the clinical picture in 25 cases (Fig 1). There were 8 men and 17 women. These were distributed as follows: 9 white, 6 being men and 3 women, 9 colored, all being women, and 7 Porto Ricans, 2 being men and 5 women.

The average age of this group is 34 years. This average is higher than that of the glandular cases. This is understandable when one considers the prolonged insidious evolution of the disease in its rectal manifestations. The rectal findings actually represent a secondary phase in the spread of the disease from an original focus on the genitalia. The oldest patient was 58 while the youngest was an 8 year old Porto Rican girl. The latter is the youngest female case on record. She is the child of Porto Rican parents, both of whom have positive Frei tests. The father had inguinal nodes and the mother has a colostomy for stricture (2).

A definite history of an initial lesion was obtainable in only 9 of the 25 cases reported. Of these, 3 were undoubtedly primary lesions in the rectum, 1 in the Porto Rican child of 8 whose symptoms and signs began after injury to the rectal mucosa by an enema tip used by her infected mother, the 2 others were primary lesions in Porto Rican men who volunteered a history of pederasty. However, practically all of the female cases gave a history of some infection of the genital tract, the nature of which could not be attributed to either lues or gonorrhea. The lesions consisted of ulcerations in the vagina, cervix, or about the urethra.

The onset of rectal symptoms occurred as early as 6 weeks or as late as 12 years after a presumed primary infection. The symptoms in order of frequency were blood in the stool, painful defecation, progressive obstipation, growth about the rectum, and pus in the stool.

Enlargement of the inguinal glands was present in 7 of the 25 rectal cases reported. This included only one female. In 6 of the 8 male cases reported there was a definite history of enlargement or supuration of the inguinal lymph nodes bilaterally.



Fig 1 A case of lymphogranuloma venereum with rectal stricture showing perianal and pudendal lesions

These findings are in accord with the accepted view that in males the primary lesion produces an inguinal adenopathy first, no matter what the sequelae may be. The exception to this rule arises when the rectum itself is the site of the primary lesion, as occurs in pederasty. This proved to be the case in 2 Porto Rican men showing rectal lesions without previous inguinal glandular involvement. They both volunteered a history of rectal intercourse to which time they were able to trace the onset of their symptoms. The Wassermann reaction was negative in all but 1 of this group of 25 rectal cases.

The site of the rectal lesions was limited to the lowest 8 centimeters of the rectum. An abrupt transition from diseased to relatively normal mucosa was found was nearly always demonstrable. The disease presented a varied picture, viz, fistula-in-ano, pelvic cellulitis, acute and chronic proctitis and periproctitis, perianal condylomas, and fibrous stricture of the rectum (Fig 2).

Biopsy specimens were obtained from the rectal lesions in 9 cases. All of these showed a pathological picture of chronic non-specific inflammation. The inflammatory reaction was more or less severe according to the type of lesion present. There was marked cellular infiltration of the sub-



Fig. 3. Structure of the rectal and lymphoid tissue in the case of lymphogranuloma.

mucosa predominantly by plasma cells. There were occasional areas of focal necrosis perivascular plasma cell infiltration endophlebitis and focal accumulations of epithelioid cells and giant cells of the Langhans type. This type of pathological picture is helpful only in making a diagnosis by exclusion of other known rectal pathological lesions such as carcinoma, tuberculosis or leues with which it may be confused clinically. The non-specific character of the rectal lesion is consistent with the present knowledge of the evolution of the extraglandular lesions. The rectal changes are merely secondary. The specific lesion itself is present but out of sight in the pelvic glands. These glands show histologically the



Fig. 4. Gross section of the rectal lymphoid tissue in the case of lymphogranuloma. The focal nodules are the lymphoid tissue. Each nodule is composed of an epithelioid cell.



Fig. 5. A chronic inflammatory process of the lymphoid tissue in the case of lymphogranuloma.

identical lesion seen in the inguinal nodes. The inflammatory changes in the rectal wall have been mistaken for syphilis or tuberculosis or non-specific chronic proctitis. They are all indeed chronic granulomatous lesions but all require confirmatory methods for establishing a specific diagnosis.

The treatment of the rectal cases varied according to the surgical indications as they presented themselves. Colostomy was necessary in 3 female patients. Two of these cases were reoperated upon through a parasacral incision and the rectum freed from the perirectal fat in an effort to relax the structure. This proved impossible in one case because of extensive scarring and gave unsatisfactory results in the other. Tartar emetic and foudadin were used in 5 other cases without any beneficial effect. Bougie and digital dilatation were employed in 4 cases, foreign protein therapy in 1 case and arsphenamine in another, all without effect upon the local lesion. Repeated injection of Frei antigen 0.1 cubic centimeter every second day in an effort at desensitization was used in 4 cases over a period of 2 years. As many as 60 intradermal injections were given. The results at the beginning of the treatment looked encouraging but after 3 months of treatment the lesions became stationary. Symptomatically these patients feel better but their local lesions in the rectum show no evidence of regression.

palliative treatment such as cotton seed oil instillations, mineral oil by mouth, a low residue diet may be used first in this type of case. Surgical indications may be taken care of when they arise. Colostomy may be necessary.



Fig 5 Epithelioid nodule in a lymph node removed 2 months after the onset of symptoms. Note the invasion of the center by leucocytes, plasma cells, and the absence of extensive necrosis

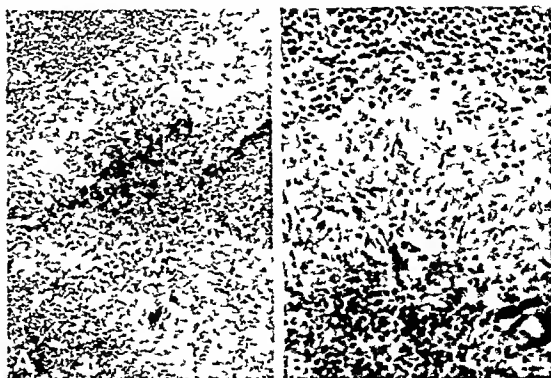


Fig 6 The periphery of an epithelioid nodule in a lymph node removed 6 months after the onset of symptoms. Note A, left, the giant cells and the invasion of the epithelioid zone by leucocytes and plasma cells, B, right, the palisading of the epithelioid elements

Attempts at repair of rectovaginal fistulas or of anal fistulas encounter little success. The tissue used in the repair is diseased and does not heal well.

**Genital lesions** A group of 5 cases is reported in which the genital lesions persisted beyond the usual 2 weeks period. This feature has not been described previously as such. It forms a definite entity, however, and shows characteristics which identify it with the glandular and rectal forms already described.

There were 3 men and 2 women, 1 white man, 2 colored men, and 2 Porto Rican women.

The average age was 35 years.

The primary lesions in the males began on the corona, glans penis, or the shaft (Fig 3). These were papular and vesicular in character. In the women the lesions were ulcerations in the vagina at the fourchette and upon the cervix. The disease was progressive from the onset and caused progressive inflammatory erosion of the glans and shaft of the penis, in the male, and of the vagina and cervix in the female. The lesion continued unhealed from 3 months to 12 years.

Glandular enlargement in the inguinal region was present in all of this group. Search for Durey bacilli was negative. No gonococci were found.

Biopsy specimens were obtained in 4 of the 5 cases. Pathologically these lesions presented chronic non-specific inflammation, similar to that seen in biopsies of rectal lesions.

The local lesions observed were primary ones which had gone on to further ulceration or perhaps

secondary chronic stages of this disease. There is a possibility too that they represent re-infections which made the local lesions assume a different character. The only common histological factor among this group is that the lesions are chronic and inflammatory, otherwise there is nothing specific in the local lesion itself. Here again the biopsy is helpful only in ruling out any other known pathological process. It is not, however, sufficient for specific diagnosis.

The treatment of the genital lesions varied. A good result was obtained in one case with potassium antimony tartrate. In another case, a woman with a pelvic exudate, radiotherapy proved beneficial. In the 3 remaining cases, tartar emetic, arsphenamine, and 1 per cent acriflavine ointment did not affect the local lesion at all.

Again in this group conservative treatment is advisable before radical surgical measures are contemplated.

#### PATHOLOGY

**Lymph nodes** The excised inguinal mass consists of an agglomeration of enlarged glands matted together by an edematous granulation tissue. The capsule appears grayish-red and granular. There are also present punctate raised zones which correspond to areas of softening within the gland substance (Fig 4). The gland as a whole feels soft and flabby. On section each node reveals many round or irregularly delineated grayish-yellow opaque nodules. These appear like minute abscesses, slightly raised above the surface upon a light gray-red background. The gland may be diffusely speckled with these nodules, but is hardly ever found to be completely necrotic.



Fig 7 A local nodal mass with a central area of necrosis and surrounding cellular reaction. The giant cells are peripheral.

Histologically the capsule is thickened and fibrous. It shows recent vascularization and infiltration with plasma cells. The septa are similarly affected. The general architecture of the gland is retained to a greater or lesser extent. The glandular parenchyma, however, is altered in the following manner. A general hyperplasia of the lymphatic tissue is present. The lymph follicles are markedly enlarged. The secondary follicles are particularly prominent and show conspicuous reticulum cell proliferation. There is a marked



Fig 8 Lymph node removed from the pelvis at post-mortem examination. The capsule is thickened and the surrounding tissue is infiltrated.

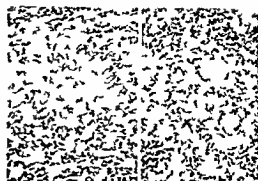


Fig 9 Biopsy of the rectum showing a central area of necrosis and surrounding cellular reaction. The giant cells are peripheral.

proliferation of the sinus endothelium. The follicles and sinuses are infiltrated by inflammatory elements remarkable for their polymorphism. This is unlike the mononuclear cell reaction in tuberculosis. True caseation and calcification are never found.

The inflammatory constituents here include plasma cells, neutrophils and eosinophilic polymorphonuclear leucocytes and large mononuclear cells from the reticulo-endothelium in addition to multinucleated giant cells.

The grayish yellow opaque nodules referred to appear microscopically as clusters of cells scattered throughout the gland. These clusters consist of large mononuclear cells with pale nuclei and

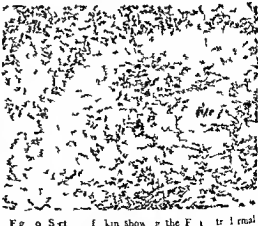


Fig 10 Section of the lymph node showing a central area of necrosis and surrounding cellular reaction. The giant cells are peripheral.



ranged radially in a palisaded manner (Figs 5 and 6). Among these cells there occur multinucleated giant cells with peripherally arranged nuclei, not unlike those found in tuberculosis or lues (Fig 7). On this account these lesions have been referred to by the French as *gummas*. Their number varies considerably. In some cases they are very numerous and scattered all over the gland, in others, especially the late cases, they are comparatively few. Subsequent changes consist in a process of degeneration whereby the center of the nodule becomes necrotic and manifests a core composed of an amorphous, finely granular or homogeneous material. This core is derived from degenerated cells and is surrounded by a thick layer of epithelioid cells among which there are a good many giant cells. This histological picture has been referred to as a "micro-abscess." It is round, oval or irregularly branching, and very often stellate (Fig 7). The central portions, containing granular debris, are filled with acidophilic mononuclear macrophages and polymorphonuclear leucocytes. The former cells contain engulfed nuclear fragments. Chromatin-staining bodies, semilunar, dumb-bell-shaped, or pear-shaped, occur free as well as in the monocytes and have been called *Gamna* bodies, after the observer who first described them. He suggested that they were cell inclusions associated with the virus. It is more likely that they represent nuclear debris.

The fibrillar reticulum, as shown by a silver stain, is well preserved throughout the gland but appears as broken up, thin, irregular shreds within the necrotic center of the nodules described.

This pathological picture in the glands may be taken as characteristic of the disease and reliable for diagnosis.

The earlier stages show more necrosis. The later ones show more fibrosis and chronic adenitis, with a predominance of plasma cell infiltration. In cases which have gone on for more than 5 or 6 months, the specific lesions do not appear clearly. They have probably disappeared for the most part. The specific lesion, however, is still retained in one place or another. This takes on the form of a small epithelioid cell nodule, focal in character, in the cortical zone of the lymph node, and surrounded by a mantle of plasma cells which also invade and distort the epithelioid cell clusters.

*Rectal lesions.* Among the rectal cases the biopsy specimens in three showed areas of necrosis, distinct perivascular infiltration by plasma cells, occasional giant cells (Fig 8), and marked vascular changes indicating an obliterating endophlebitis. The histological picture was somewhat sug-

gestive of syphilis. However, the Wassermann test and a therapeutic test were persistently negative. This leads one to view these lesions as suggestive of lymphogranuloma venereum, particularly when supported by the presence of a positive Frei test. The pelvic glands, removed at postmortem, do show lesions identical with those of the inguinal glands (Fig 9).

*Genital lesions.* When the genital lesions are reviewed it is again noted that some suggest the picture of syphilis, not unlike the rectal lesions. On excision of an initial lesion, the changes found on histological examination are of the same nature though varying somewhat in degree, whether the lesion is in the form of a little herpetiform ulcer, a papule, or a nodule (5). At the edges of the lesion the epidermis is thickened, the interpapillary prolongations are wider, the papillae are thinned or the interdigitations may have entirely disappeared, the several layers being flattened out by a stratum of infiltration which invades the papillary layer and the superficial part of the dermis. Where there has been a solution of continuity of the surface, the stratum granulosum and the stratum lucidum are destroyed, thus exposing the cavity of the lesion filled with amorphous and cellular debris. The cavity is surrounded not by granulation tissue but by an altered connective tissue filled with lymph cells resembling somewhat a lymph follicle. The Malpighian layer and the prickle cell layer are swollen and edematous, there being both intercellular and intracellular edema of the epidermis leading in places to the formation of a fine spongy vacuolation. Many mitotic figures are visible.

The cellular infiltration is composed of plasma cells, lymphocytes, swollen connective tissue cells, also cells with two or more nuclei. Free nuclei are noted. These look like the *Gamna* bodies (4). In the subjacent dermis the blood vessels are engorged but though the endothelium is swollen there is little noticeable perivascular infiltration. In other cases the process is more advanced, resembling that in the glands, with the formation of the characteristic micro-abscesses lined by epithelioid cells, marked infiltration with finely granular oxyphile cells and macrophages containing cell inclusions (*Gamna* bodies).

*The Frei test.* It is remarkable that the description of the primary lesion corresponds in every way to that of the Frei intradermal reaction. A section of skin showing a positive reaction was removed for histological examination. It shows the characteristic subcutaneous infiltration and necrotic nodule described. It is the formation of this nodule that indicates a positive reaction.

(Fig. 10) The surrounding erythema represents a secondary non specific congestion and tissue reaction about this necrotic nodule. This is readily demonstrable on histologic section.

The primary lesion is thus a papule showing acute inflammation with necrosis and nodule formation like the picture of the acute stage seen in the glands. This lesion usually heals rapidly with the formation of a thin scar. If this primary lesion spreads and becomes chronic the striking pathological picture of the first phase becomes less evident. The lesion now consists of epithelioid nodules, perivascular plasma cell infiltration, endothelitis and giant cells. This picture is similar to the rectal lesions. These lesions are also suggestive of syphilis. However the Wassermann reaction in these cases is negative as are therapeutic tests. Although these chronic lesions do not conform to the histological picture of the acute necrotic nodule they do suggest a later phase of this disease similar to the same process seen in the glands and in the rectal wall. These later genital lesions can be traced clinically as extensions from an acute primary lesion. It is therefore reasonable to assume that the histological picture presented is that of lymphogranuloma venereum in a later stage. This is stated in spite of the appearance suggestive of syphilis and supported by the presence of a positive Frei test.

#### EXPERIMENTAL TRANSMISSION

Between 1913 and 1922 attempts at transmission of lymphogranuloma venereum to animals were practically uniformly unsuccessful. Since then the transmission has been successful in a number of animal experiments. In order of susceptibility may be mentioned the monkey, the white mouse, the guinea pig, the rabbit, the cat and the dog. The following series of transfers have been effected: rabbit's brain to rabbit's gland to guinea pig's gland to rabbit's gland to rabbit's brain.

The earlier investigators were content to consider a local glandular enlargement produced by subcutaneous injection as sufficient proof of the transfer of the disease. Later investigators excised the glands and reported changes similar to those obtained in the human cases (6). However the lack of photomicrographs in their publications makes it difficult to verify the histological picture found in their experiments. At least 10 investigators reported failures with the subcutaneous injection method.

The intracerebral injection of the pus obtained from known cases however offered more consistent positive results. A meningo-encephalitis

is reported. Focal necrosis with focal accumulation of lymphocytes in addition to perivascular infiltration of the cerebral vessels are given as specific evidences for the successful transfer of the disease. Numerous reports are confirmatory of the findings of a meningo-encephalitis. However the specificity of such lesions is open to doubt. The injection of any foreign irritant is likely to produce similar changes.

The experiments in themselves are important in that the virus can be preserved in the brain tissue of animals and that an emulsion of brain substance infected by the virus will produce a positive reaction in known cases of lymphogranuloma venereum (8).

Ten guinea pigs were injected in the inguinal region with material obtained from known cases of the disease. The pus was obtained in the operating room under sterile precautions. Four cubic centimeters were used for each guinea pig. All of the guinea pigs developed a glandular enlargement within a period of 10 days. All of the glands that were excised after about 3 weeks showed a lymphoid hyperplasia and nothing more. Bacteriological cultures of these glands were all sterile. In all of the glands which were not excised the process subsided spontaneously. None broke down.

Transfers were attempted in four guinea pigs with both filtrate and macerated glands. These four presented a glandular enlargement which histologically looked like a lymphoid hyperplasia. None of the glands removed showed a picture similar to the human. Frei tests done on these guinea pigs were positive while controls were negative. At postmortem there was no glandular enlargement and no lesions were found in the liver or lungs. This is somewhat contrary to the findings by recent investigators.

#### CONCLUSION

We are dealing with an infectious disease caused by a filtrable virus and disseminated by way of the lymphatics. It is inflammatory in character and consequently may appear in acute, subacute or chronic stages. The disease process does not proceed along the lines of any simple well defined pattern. The clinical manifestations are either the local primary lesion, an enlargement of the regional nodes or the consequent alterations in the neighboring anatomical structures, the lymphatic drainage of which is dependent upon the nodes affected. The failure to recognize this multiplicity of syndromes resulted in a confusing terminology or lack of recognition of the common agent.

With the introduction of the Frei test and a more thorough review of the histology of the lesion, all of these syndromes may now be grouped under the one head of lymphogranuloma venereum. The variability of the symptoms depends upon the extent and character of the anatomical involvement. The objective findings, likewise, will be different in each case, varying with the extent of the region involved and the amount of inflammatory reaction taking place.

The histopathological unit of this disease is an inflammatory nodule which undergoes necrosis. The primary lesion demonstrates this nodule in its simplest form. The nodule produced by the Frei intradermal reaction reproduces the lesion identically in every respect. A single lesion may be described as a shell of palisaded layers of epithelioid cells with a central granular core. The contents of this central portion consist of the cellular debris of leucocytes, lymphocytes, and endothelial cells of which this nodule was originally composed. Plasma cells appear in the later stages.

If this necrotic material breaks through its limiting shell and invades the skin, a sinus forms. If the breaking down takes place within the node itself, a coalescent abscess forms. If each individual inflammatory nodule involves the skin and breaks through it, multiple sinuses form. Each of these sinuses drains a separate focus. In the endopelvic fascia, the same holds true. The amount of breaking down determines the extent of the lesion. Small distinct inflammatory foci coalesce to produce larger ulcerations.

The virus is apparently a sluggish one insofar as the disease that it produces may go on in its evolution either to spontaneous healing or to chronicity. Whereas it was previously believed that all cases go on to suppuration, this belief is subject to modification when more cases are reviewed. The fact that many different non-specific methods of treatment effect a cure also speaks well for the possibility of spontaneous cures. However, since this disease is caused by a virus, a biological approach toward therapy seems rational. A method of desensitization seems the desirable form of treatment. Thus far this method has shown much promise.

#### CASE REPORTS

##### *Glandular Lesions*

CASE 1. The following case is fairly typical of the course in a white man showing glandular involvement.

E. L., a 23 year old Italian male laborer, was admitted to the surgical service of Dr. Edwin Beer. He had had coitus with a negro 3 weeks prior to admission. At the time of exposure he noted a small injury at the frenulum. This le-

sion healed slowly and at the time of admission appeared as a flat subchronic ulceration 5 millimeters in width. Within 1 week after exposure, he noted a progressive enlargement of his inguinal glands on the left side which became painful. He ran a fever to 104 degrees F., had many chills, and lost about 20 pounds in 3 weeks.

The patient presented a large left inguinal abscess and many broken down lymph nodes. In addition, he had a small ulceration, 5 millimeters wide, at the frenulum. He was operated upon and the abscess evacuated. A number of broken down lymph nodes were removed and the patient was treated with 50 per cent glycerine wet dressings. This was done with the knowledge that the virus is unstable in glycerine. This type of dressing gave the patient the greatest relief. The penile lesion healed spontaneously within 3 weeks, without any treatment, leaving a thin scar. The inguinal lesion healed firmly within 2 months and left a deep pitted scar.

The Wassermann and Kahn reactions were negative. The Frei test was strongly positive. A dark field examination of the exudate from the primary lesion showed no spirochetes. Culture of the pus showed no growth.

*Microscopic examination.* The lymph node removed showed lesions indicative of lymphogranuloma venereum. A biopsy of the penile lesion showed chronic inflammation. A section of the skin at the point of injection of the Frei material was removed. This presented a necrotic intradermal nodule. The histological changes in the skin nodule were similar to the changes found in the inguinal gland.

##### *Rectal Lesions*

The following case illustrates the course of an acute rectal lesion in a white male and the effect of intradermal Frei antigen as a therapeutic agent.

CASE 2. M. E., a 58 year old Turkish Jew, was admitted to the medical service of Dr. B. S. Oppenheimer. The patient had contracted syphilis and gonorrhea 6 years previously. At that time he had received four intravenous and intramuscular injections. Seven months previous to his admission he was operated upon for a fistula-in-ano. He had complained of pain in the rectum and a bloody discharge from the rectum. At the same time he was operated upon for a left inguinal adenitis. During the 4 months previous to his admission he suffered from increasing loss of weight. He had a bloody diarrhea, and much mucus in his stool.

The patient's status was essentially negative except for his local findings. The left inguinal nodes were found to be enlarged and firm. There was a perfectly well healed scar over these nodes. Rectal examination showed a marked periproctitis with a small periproctitic abscess. The rectal lesion conformed to that of a granulomatous proctitis. Sigmoidoscopy showed a sharply demarcated lesion which began at the anus and involved the rectum upward for a distance of 7 centimeters where it stopped abruptly. The mucous membrane presented a cobblestone appearance, was very granular, and bled easily. The perianal (or perirectal) tissues showed marked infiltration. The rectal segment involved felt rigid and fixed to the surrounding endopelvic fascia. There was no stenosis. There were multiple anal fistulas and the rectum contained a raspberry-juice-like secretion. The mucous membrane above the lesion had a normal appearance.

The patient was treated in the wards for a period of 2 months. He was given a course of antiluetic therapy. In addition, he was given azochloramid per rectum. He was also given a course of foudadin (10 doses from 15 cubic centi-



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## ✓<sup>R</sup> ABORTION

### A STATISTICAL ANALYSIS OF 2,287 CASES

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THE problem of abortion is an extremely important one, not only to the practicing physician but to the community at large. Spontaneous expulsion of the ovum prior to the twentieth week of gestation is a frequent and often serious complication, occurring, according to Williams, in approximately 1 of every 5 pregnancies. It is probable that this incidence is too low since it does not include many of the very early cases which are recorded merely as "delayed" menstrual periods. It is utterly impossible to arrive at any accurate estimate of the frequency of self-induced and criminal abortion, although many authorities have expressed the opinion that they at least equal the spontaneous type in number and probably exceed it. The mortality resulting from criminal abortion is also a matter of conjecture, but it is agreed to be very high, and Liepmann has stated that it causes approximately 25,000 deaths each year in Germany.

The number of abortions observed on the obstetric service of a university hospital is usually

small in proportion to deliveries at or near term. This is due not only to a rather general policy on the part of hospital authorities to discourage this type of admission except in case of emergency, but also because the patients themselves seem to prefer home treatment for this condition. Complicating factors, such as excessive hemorrhage or infection, are usually the direct reason for admission in those cases seen on a clinic service, with an additional small number of abortions which have been induced for therapeutic reasons. From the time of its inception in 1896 to the end of 1934, a total of 2,287 patients with abortion had been observed and treated on the obstetric service of the Johns Hopkins Hospital. It is our purpose in the following paragraphs to offer a brief analysis of this series which comprises 7.60 per cent of the total admissions to the service. For this purpose the case records have been carefully examined in an effort to ascertain points of interest concerning the abortion problem and also to determine the

TABLE I—TYPE OF ABORTION

	Number	Per cent of total
Spontaneous	763	33.36
Operative	1196	52.30
Missed	41	1.79
Therapeutic	287	12.55
Total	2287	

TABLE II—RACE AND AGE

	Race		Mean age
	White %	Black %	
Spontaneous	52.69	47.31	25 yrs 5 mos
Operative	70.23	29.77	28 yrs 9 mos
Missed	65.85	34.15	27 yrs 6 mos
Therapeutic	73.17	26.83	30 yrs 2 mos
Total excluding therapeutic	63.45	36.55	27 yrs 5 mos

TABLE IIA—PARITY

Parity	Spontaneous—%	Operative—%	Missed %	Therapeutic—%	Total—excluding therapeutic—%
1	24.77	12.21	21.95	16.38	17.40
2, 3	34.07	25.75	29.76	25.73	29.00
4, 5	17.04	23.49	7.32	10.56	20.70
6, 7	11.53	14.72	26.83	14.63	13.75
8, 9	5.90	10.87	4.83	7.66	8.85
10 and over	6.42	12.04	9.76	13.59	9.85
Unknown	0.26	0.92	0.00	1.39	0.65

(\*It will be noted that in this and subsequent tables the totals computed exclude therapeutic abortion. It is believed that by so doing a more accurate picture of abortions in general is attained, since the latter group is a highly selective one having nothing in common with the others of the series except the premature termination of the pregnancy.)

TABLE III—SOCIAL STATUS

Social status	Total no.
Single	10 18
Married	87 90
Widow	0 78
Divorced	1 04

existence of racial differences if any between the white and black patients comprising the series.

Table I summarizes the series according to the type of abortion. Since this nomenclature will be used throughout the analysis, these terms may well be defined at this point. Spontaneous abortion is limited to those cases giving no history of criminal attempt and with completion occurring without operative aid. The operative group includes all cases of inevitable or incomplete abortion completed by digital or instrumental curettage but does not include instances of vaginal hysterotomy. Missed abortion has been diagnosed whenever it seemed clear that a month or more had elapsed between the death of the product of conception and the actual miscarriage. The term therapeutic abortion conforms to the common usage. The fetus in no instance attained a length of 35 centimeters or a weight exceeding 1500 grams.

The following analyses of the material have been made:

The race, age and parity are given in Table II and IIIA.

The clinic population from which these cases are drawn is made up about equally of white and black patients. In contrast to this will be seen from Table II that almost two-thirds of the patients with abortions were white. Moreover distinct racial differences were noted according to the type of abortion as was evidenced by a very slight preponderance of whites over blacks in the spontaneous group (52.69 and 47.31 per cent respectively) while for the operative group percentages of 9.23 and 9.77 respectively were found. Whether or not this is a true racial difference is not clear but it seems probable that a part of the discrepancy at least is to be explained in terms of the greater number of induced abortions on the part of the white patients.

The mean age of the patients in the series was 27 years 3 months, a figure considerably higher than that found for the general clinic population (23 years 10 months). Similarly only 1.0 per cent of the abortions occurred in primiparæ although more than half of the total clinic patients (54.69 per cent) were pregnant for the first time. Interesting differences were found in age and parity according to type of abortion in the

TABLE IV—PREVIOUS ABORTIONS

Previous abortions	Spontaneous	Operative	Missed	Therapeutic	Total
Total patients	120	43.40	8.95	35.50	107.85
Total primiparæ	0	0	60.00	8.57	68.57
Previous abortions	65.8	51.8	4.0	5.69	127.29
Previous abortions	1.055	98	6.6	5.00	104.65
Spontaneous abortions	6	0	0	3	9
Spontaneous abortions	5	8.4	0	7.5	20.9
Missed abortions	3.73		6.67	1	11.4
All cases with previous abortions	7			86	93

group with spontaneous termination was much younger and contained twice as high a percentage of primiparæ as did the operative group. In general the missed abortion series approximated the operative group in characteristics of race, age and parity more closely than the spontaneous. Naturally the patients with therapeutic abortions were largely multiparæ and in the older age groups.

Table III indicates the social status of the patients in the series, although it is not our intention to suggest that the figures are characteristic in this respect for abortions in general. It is interesting to note that the incidence of unmarried patients is twice as high (21.80 per cent) in the general clinic population as in this series, a figure to be explained in terms of the large number of colored women cared for by the service and also since the clinic delivers the inmates of a home for unmarried white women.

Table IV indicates the proportion of patients in the series who had had previous abortions and also the number of abortions which they had. It will be noted that almost two-fifths (39.08 per cent) of the total patients had miscarried one or more times previously, the incidence being highest in the missed abortion group (48.39 per cent) and lowest in the spontaneous type (32.92 per cent). Excluding primiparæ we obtained the high figure of 46.62 per cent previous abortions. The majority of these patients have a history of only one previous abortion but over one-fifth of them had had three or more. Furthermore the incidence of this latter type of patient was much higher in the operative than in the spontaneous group, the percentages being 4.54 and 7.49 respectively. Four patients in the total series claimed to have had 10 or more abortions.

On investigating the complete obstetrical history of the patients in this series, excluding the

TABLE V—INTERVAL

Time since last delivery	Spontaneous %	Operative %	Missed %	Therapeutic %	Total %
Less than 1 year	47.32	43.19	52.63	47.41	45.18
1 year	22.32	27.48	36.84	21.48	25.51
2 years	12.20	11.55	10.53	10.37	11.80
3 years	5.36	7.85	0.00	7.41	6.60
4 years and over	12.80	9.93	0.00	13.33	10.91

(Excluding primipare and unknown)

TABLE VI—DURATION OF PREGNANCY

Duration	Spontaneous—%	Operative—%	Missed %	Therapeutic—%	Spontaneous and operative only Total—%
1-4 weeks	0.49	2.40	0.00	0.00	1.58
5-8 weeks	7.64	15.90	0.00	12.42	12.35
9-12 weeks	22.66	34.57	11.54	31.68	29.46
13-16 weeks	19.21	25.14	5.85	21.74	22.60
17-20 weeks	17.98	12.57	23.08	15.53	14.89
21-24 weeks	14.04	5.13	3.35	11.18	8.93
25 weeks and over	17.98	4.24	37.69	7.45	10.13
Mean duration	16 w 5 d	12 w 4 d	24 w 0 d	14 w 1 d	14 w 3 d

with therapeutic abortion, it was found that 39.51 per cent of the total pregnancies had terminated prior to a period of viability of the fetus. It is not our contention that this rate of 2 out of 5 pregnancies terminating as abortions holds for the general childbearing population. It is, however, our impression that it may be characteristic for a clinic population composed of women from the tenement districts of a large city, who begin bearing children early and repeat their pregnancies at close intervals.

Table V gives the interval between last pregnancy and one ending in abortion.

It has been suggested that the abortion rate increases in women repeating the childbearing process at frequent intervals. In the series under analysis, containing 83 per cent multiparæ, the large majority of patients had undergone a previous pregnancy recently. Thus 45 per cent had been delivered less than 1 year and 70 per cent less than 2 years prior to the gestation terminating in abortion. This not only indicates the fertility and close spacing of pregnancies in women of this type, but is, in our opinion, suggestive evidence of an increased abortion rate among them. In a similar series in which the pregnancy went to term, we found the conception occurring within a year of the previous delivery in only 30 per cent.

TABLE VII—DURATION OF SYMPTOMS BEFORE COMPLETION OF ABORTION

Duration	Spontaneous—%	Operative—%	Missed %	Spontaneous and operative only Total—%
1-4 weeks	50.94	59.42	20.00	55.22
5-8 weeks	32.08	26.81	70.00	30.35
9-12 weeks	13.21	7.25	0.00	8.46
13 weeks and over	3.78	6.52	10.00	5.97
Mean duration	4 w 4 d	4 w 3 d	6 w 3 d	4 w 4 d

Table VI indicates the time interval in weeks between the onset of the last regular menstrual period and the completion of abortion. It will be noted that the incidence of cases occurring in the first 8 weeks was more than twice as high in the operative (18.30 per cent) as in the spontaneous (8.13 per cent) group. Conversely 50.00 per cent of the spontaneous abortions occurred after the fourth lunar month, as contrasted with 21.99 per cent for the operative type. The mean interval was 16 weeks 5 days for the spontaneous group, as contrasted with 12 weeks 4 days for the operative, while for missed abortions 24 weeks elapsed. It is interesting to note that for the three groups—spontaneous, operative, and missed—the total duration was closely in terms of lunar months, which might be interpreted in terms of the "menstrual wave" as an associated factor.

Table VII indicates the interval between the onset of symptoms, lower abdominal cramps and bleeding, and the time of completion of the abortion. Little difference was noted between the spontaneous and operative types, but for missed abortion 6 weeks elapsed between onset of premonitory signs and the expulsion of the ovum. In one-seventh of the total cases, excluding missed abortion, more than 8 weeks elapsed, in many instances probably indicating a prolonged period of retention of the product of conception subsequent to death of the fetus.

*Number of days of hospitalization.* Nine days was the average term of hospitalization required for the spontaneous, operative, and missed abortion groups. In the therapeutic type the period was necessarily longer (21 days), because of the medical complications which had been the indication for the premature termination of the pregnancy. Ten per cent of the patients with spontaneous or operative completion had to be kept in bed for over 2 weeks, and 5 per cent for 3 weeks or more. In several instances prolonged hospitalization of 50 days or more was necessary because of infec-

TABLE VIII—INTRAPARTUM INFECTION

	Per	Total case
Spontaneous		66
Operative		6
Missed		77
Therapeutic		44
Total		

TABLE IX—PUERPERAL MORBIDITY

Puerperal	Spontaneous	Operative	Missed	Therapeutic	Total
Abortion	435	2865	237	6065	75
Fetal puerperal infection	560	65	43	6	880
Fetal, other causes		5	4	95	5
Total puerperal	30	8	00	35	10

tion and 3 patients were observed for more than 3 months. These figures are included to emphasize the importance of the abortion problem economically to both the patient and the hospital.

The definition of intrapartum infection employed at the clinic is a temperature of 100.4 degrees F or above occurring prior to the completion of abortion and not due to extragenital causes. The clinic policy has been one of non-interference in cases of incomplete infected abortion unless necessitated by hemorrhage until clinical signs of the infection have subsided. It will be seen from Table VIII that one sixth of the spontaneous and one fourth of the operative cases manifested a febrile reaction prior to completion. Excluding therapeutic abortion the mean incidence of intrapartum infection was 21.10 per cent which may be contrasted with the figure of 2.55 per cent occurring in patients delivered at or near term.

It is the custom of the clinic to diagnose puerperal infection clinically in the presence of fever (100.4 degrees F or above) on 2 days of the puerperium not necessarily successive excluding the first 24 hours after delivery and after having ruled out other causes such as pyelitis or respiratory infection. It will be seen from Table IX that following abortion the puerperium was febrile due to puerperal infection in 18.80 per cent of the cases the incidence being higher in the operative group than when completion was spontaneous. This figure would seem to compare favorably with an incidence of 17.50 per cent in infection following delivery at or near term. However the general clinic population is made up almost equally of white and black patients with puerperal infection occurring much more frequently among the latter whereas in the abortion series the whites outnumber the blacks two to one. Therefore in our experience the chances

TABLE X—INDICATIONS FOR OPERATION

	Operative	Missed	Therapeutic
Indication			
Incomplete abortion	366	500	000
Incomplete abortion	43	1000	
Missed abortion		3000	
Hemorrhage	5103	5500	
Prolapsed cord or placenta	048		
Infection	080		
Toxemia			4056
Cervical disease			1333
Tuberculosis			100
Psychiatric disease			172
Pyelitis			444
Other diseases			1444
Infant mortality complete	063		

of infection seem to be greater following abortion than delivery at term.

*Incidence of admitted criminal procedures.* Excluding cases of therapeutic abortion the incidence of admitted criminal procedures among the patients of the series was 8.97 per cent and was slightly lower in the single than in the married group. To what extent this figure represents the true picture is impossible to state but in view of the generally known difficulty in procuring such an admission from the patient it is probably far too low. In our experience it is extremely rare for a colored woman to induce an abortion upon herself or to have such a procedure done by midwife or doctor. The great majority of admitted criminal attempts were in the white portion of the series and for them the incidence was 14 per cent.

In well over half of the total admitted criminal abortions the method employed was the introduction of a bougie or rubber catheter while a slippery elm stick was used in about a quarter of the cases. Two other methods admitted by a number of the patients were the introduction of a sound or other metal instrument and the insertion of a sea tangle tent. A pencil hatpin, nut pick or glass rod was used by the occasional patient and one woman induced abortion by the intra uterine injection of turpentine.

The indications for surgical interference in the operative and missed abortion groups together with the disease conditions forming the basis for induction of the therapeutic abortions are shown in Table X. It will be noted that hemorrhage of sufficient degree to necessitate emptying the uterus occurred in over half the cases of operative and missed abortion. Infection was the indication for operation in only 0.80 per cent which illustrates the conservative policy employed by the clinic in this type of case. The four main indications for the induction of therapeutic abortion were toxemia including nephritis and toxemic



TABLE XI—CONDITION AT TIME OF OPERATION  
(FEBRILE OR AFEBRILE)

Condition at time of operation	Operative %	Missed %	Therapeutic— %
Febrile	13.04	15.00	5.00
Afebrile	86.80	85.00	95.00
Information lacking	0.16	0.00	0.00

TABLE XII—INTRA-UTERINE CULTURES

Organisms found	Per cent
Hemolytic streptococcus	7.83
Aerobic non hemolytic streptococcus	26.96
Anaerobic streptococcus	35.65
Streptococcus viridans	2.61
Undifferentiated streptococcus	1.74
Total streptococcus	74.78
Staphylococcus aureus	3.48
Staphylococcus albus	12.61
Undifferentiated staphylococcus	0.96
Total staphylococcus	33.05
Bacillus coli	13.04
Bacillus welchii	3.48
Bacillus pseudonecrophorus	1.74
Gonococcus	0.87
Diphtheroids alone	2.61
Undifferentiated bacteria alone	4.35

vomiting, cardiac disease, tuberculosis, and psychiatric conditions, such as epilepsy, psychoses, and mental deficiency. In the group listed "other conditions" are included such miscellaneous factors as primary anemia, hydatidiform mole, hyperthyroidism, the fear of a third microcephalic child, etc.

Table XI is included to indicate that, despite the clinic policy of the avoidance of operative procedures in the presence of intra-uterine infection, bleeding was sufficient to necessitate completion of the process in 13 per cent of the operative and 15 per cent of the missed abortions which were infected. Pyelitis was the cause of fever in most of the 5 per cent similarly shown for the therapeutic cases. It is our opinion that intra-uterine manipulation in the presence of frank infection materially increases the hazards to the patient in terms of spread of the process.

An intra-uterine culture was taken in most instances prior to operation, when such procedures were necessary in the presence of fever. Cultures were also done whenever infection developed after abortion. Table XII indicates the bacteriological findings from cultures taken on the four types of cases in the series. Comment on this table seems unnecessary except to state that the percentage incidence of organisms found agrees rather closely with findings similarly ob-

TABLE XIII—DEATHS

Total deaths	Spontaneous —%	Operative %	Missed %	Therapeutic %	Total %
Afebrile on admission	0.524	0.669	0.000	4.878	0.600
Febrile on admission	0.917	1.171	2.439	0.348	1.100
Total	1.441	1.840	2.439	5.226	1.700
Deaths infection					
Afebrile on admission	0.000	0.418	0.000	1.046	0.250
Febrile on admission	0.917	1.171	2.439	0.000	1.100
Total	0.917	1.589	2.439	1.046	1.350

tained from a series of cultures on patients with clinical puerperal infection following delivery at or near term. Only two differences manifested themselves, the incidence of anaerobic streptococcus was lower and that of the colon bacillus higher in the abortion than in the term delivery group.

Of the total 2,287 cases of abortion in the series, there were 49 maternal deaths, of these 23 patients were febrile and 26 afebrile on admission to the hospital. The gross death rate, excluding therapeutic abortions, was 1.700 per cent and was highest in the missed and lowest in the spontaneous abortion group. However, the high rate in the missed abortion series may be discarded, since it represents one death from infection in a total of 41 cases. The mortality rate of 5.226 per cent in the therapeutic abortion group was to be expected and in most cases was due to the condition necessitating the interruption of pregnancy. Thus 19 of the deaths were due to unrelated causes, such as nephritis, toxemia, vomiting, cardiac disease, lobar pneumonia, carcinoma, and typhoid fever, leaving a mortality due to infection of 1.350 per cent, excluding therapeutic abortion. The patients constituting the series have been divided according to whether or not they showed signs of clinical infection in terms of fever at the time of admission to the hospital. This division is not an accurate one, since undoubtedly some of the women were infected prior to admission, although the condition had not yet progressed sufficiently to produce fever. Again excluding therapeutic abortions, the mortality rate due to infection, in patients afebrile on admission, was 0.250 per cent, or 1 in 400, with all the deaths occurring in the operative group. The higher rate of 1.100 per cent was obtained for the group "febrile on admission." It is interesting to note that in no instance was hemorrhage the immediate cause of death, although it undoubtedly contributed materially through a lowering of resistance to infection in a number of them.

## DEDUCTIONS

The experience of this clinic has in our opinion substantiated the wisdom of the hands off policy in cases of infected abortion. Only when hemorrhage is sufficient to necessitate immediate emptying of the uterus should operative procedures be undertaken in such patients. During the waiting period supportive therapy and Fowler's position supplemented by the use of frequent small blood transfusions (250 c cm) seems to offer the best results. Even in those patients who are admitted fever free but in whom there is any question of previous intra uterine manipulation it is better to wait 24 to 48 hours in order that a latent infection if present may manifest itself. It is our conviction that any manipulation and particularly instrumental curettage materially increases the hazards to the patient through removing the leucocytic defense wall within the uterus. During the early days of the clinic 2 deaths from septicemia occurred 48 hours after curettage in patients of this type. Moreover for the protection of the physician it is recommended that an intra uterine culture be taken prior to any operative procedure in any suspicious or frankly infected case. The safety of digital as contrasted with instrumental curettage cannot be too highly emphasized.

In the missed abortion group it is believed that waiting is again the most satisfactory policy. In a number of cases several weeks have elapsed between diagnosis and the actual passage of the product of conception with operative procedures being employed only when necessitated by the physical or mental condition of the patient. Finally when therapeutic abortion is necessary it is important to defer operation if possible until the patient's general condition has reached its maximum improvement and to perform the manipulation necessary under the most rigid surgical technique.

## SUMMARY

An analysis has been made of the records of 2 287 cases of abortion treated by the Obstetrical Service of the Johns Hopkins Hospital over a period of 38 years. These cases have been divided according to type as spontaneous operative missed and therapeutic. The following is a summary of the points resulting from this analysis.

Abortions of all types comprised 7.60 per cent of the total clinic admissions in a series of over 30 000 patients observed by the service. Omitting pregnancies terminated for therapeutic reasons 38.15 per cent of the abortions were completed spontaneously and 59.80 per cent by operative means while 2.05 per cent were cases of missed

abortion. The general clinic population is composed about equally of white and black patients while for the abortion series 63.45 per cent were white and 36.55 per cent black. A definite racial difference was noted according to the type of abortion and the percentages of white patients were 52.69, 63.85 and 70.23 for the spontaneous missed and operative groups respectively. The mean age of patients in this abortion series was 3 years 7 months greater than that of the general clinic population. The average patient with spontaneous abortion was 25 years 5 months old and 28 years 9 months in the operative group. Only 17.20 per cent of the patients with abortion were pregnant for the first time although primigravida comprise 54.69 per cent of the general clinic population. The incidence of primiparae in the operative group was only 12 per cent as contrasted with the figures of 22 and 25 per cent for the missed and spontaneous types respectively. Conversely 38 per cent of the operative abortion patients had had 5 or more previous pregnancies while this was true in only 24 per cent of the spontaneous cases. Thirty nine and eight hundredths per cent of the patients had had one or more previous abortions and excluding primiparae 46.62 per cent. The lowest incidence was in the spontaneous and the highest in the missed abortion group. Approximately one fourth of the patients with previous abortion in the operative group had had three or more whereas this was true of only one seventh of the spontaneous cases. The complete obstetrical history of the patients in the series was analyzed and it was found that 39.51 per cent of the total pregnancies had terminated prior to the period of viability for the child. Excluding primiparae 45.18 per cent of the patients had had a pregnancy less than a year prior to the one ending in abortion and 70.69 per cent of them less than 2 years. Only 21 per cent of the women had not been pregnant within the previous 4 years. The mean duration of pregnancy at the time of completion of the abortion was 14 weeks 3 days and was 4 weeks longer in the spontaneous than in the operative group. The average duration of symptoms (abdominal cramps or bleeding) before completion of the abortion was 4 weeks 4 days. Intrapartum infection in terms of temperature elevation to 100.4 degrees F or above prior to the completion of abortion was noted in 21.10 per cent of the total series and was much more common in the operative than in the spontaneous group. Only 2.44 per cent of the abortions induced for therapeutic reasons evidenced intrapartum infection and this incidence is almost identical with that occurring in patients delivered at or near

term. Allowing for the increased rate of puerperal infection found in black as contrasted with white women, the incidence of this complication was somewhat higher in this series than in the clinic's experience with patients delivered at term. Puerperal infection occurred most commonly in the missed abortion group and least so in the spontaneous group. Nineteen per cent of the patients with therapeutic abortion had febrile puerperia, due to intra-uterine infection. Only 9 per cent of the patients in the series admitted criminal attempts at induction of abortion. It is our experience that the negro makes such attempts very rarely and omitting them, the incidence becomes 14 per cent. The indication for operative completion of abortion was hemorrhage in over half of the cases in the operative and missed groups. Pove mia, psychiatric disease, cardiac disease, and tuberculosis, in the order given, were the major indications for the induction of therapeutic abortions.

Although it is a matter of clinic policy not to interfere in cases of infected abortion, yet in

approximately one-seventh of the operative and missed groups, hemorrhage was sufficient to necessitate emptying the uterus in the presence of fever. Some variety of streptococcus was obtained from 75 per cent of the intra-uterine cultures taken on infected cases. The bacteria found, as well as the incidence of each type, were approximately the same as in a series of patients with puerperal infection following delivery at or near term, except that the anaerobic streptococcus occurred less frequently and the colon bacillus more often in the abortion series. The gross mortality rate for the series, excluding therapeutic abortion, was 1.700 per cent, and was higher in the operative than in the spontaneous group. The death rate due to infection was 1.350 per cent and among patients afebrile at the time of admission to the hospital was 0.250 per cent. It is the opinion of this clinic that a conservative policy of non-interference in the presence of obvious infection offers the best results in cases of abortion. Repeated small transfusions of blood seem to have a beneficial therapeutic effect.

## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY 1936

### THE BRAIN TUMOR REGISTRY

**I**N an article recently published<sup>1</sup> Mr Hugh Cairns of London has made a careful study of the intracranial tumor cases which came under his supervision while acting as Dr Harvey Cushing's resident assistant at the Peter Bent Brigham Hospital in 1926-1927.

This study calls attention to the unique collection of over 2,000 brain tumors with the microscopical preparations and records pertaining thereto which under the custodianship of Dr Louise Eisenhardt has been set up in the Pathological Department of the Yale School of Medicine as the basis of an enlarging source of information concerning lesions of this special type. It also gives an indication of the purposes to which the collection may be put and emphasizes the manner in which it is certain to become increasingly valuable for future studies of a similar kind in years to come.

<sup>1</sup> Cairns H. The tumor as result of operations for intracranial lesions. A study of the results of surgical treatment. J. Neurol. Surg. 5: 1-10, 1936.

There is much still to be learned about brain tumors many of which have not as yet even been satisfactorily classified. It is only by continued study that the life history of one after another of the many varieties can be fully worked out so that the expectation of life and the relative freedom from incapacitation after operation of a given type of tumor found in a particular situation can be known at the time it is first brought to view. Not until the behavior of every kind of tumor is thoroughly understood by the person who attempts surgically to deal with them can it be decided which particular form of intervention whether by extirpation or irradiation will give the lowest operative mortality and at the same time the longest survival period with the least impairment of the afflicted individual's intellectual and physical capacity to earn his livelihood.

Mr Cairns' paper represents a new type of report of surgical end results and it is particularly important in the case of pathological lesions of the sort with which he has dealt. Surgeons heretofore have been satisfied to work out the operative mortality percentages and the survival periods for tumors of special kinds but to try to determine after a given period what the survivors have been good for and to what degree the spared life has been worth living is something altogether new. Such a study is only possible when records are of the best and when the relation of patients and surgeon has been on an unusually intimate basis.

In his prefatory note Dr Cushing refers to certain matters which might be regarded as controversial, one of them being the question

of to what extent outside discrimination and selection of cases might affect a surgeon's mortality percentages and survival periods. He would probably be the first to acknowledge that his known interest in pituitary disorders led patients with adenomas to frequent his clinic, doubtless on the family doctor's advice, but beyond this it is difficult to believe that there was any discrimination made in the type of cases recommended to the Brigham clinic for diagnosis and treatment. Certainly those who worked there know that no discrimination was made between favorable and unfavorable cases once the patients arrived. It was most unusual for the neurologists, ophthalmologists, or physicians who referred patients to do more than make a tentative localizing diagnosis except, naturally enough, in the case of acoustic tumors, in which the localizing diagnosis usually indicated the nature of the tumor as well.

It should be remembered, also, that until a pathological classification was worked out upon the tumors encountered in Cushing's clinic, no attempt had been made to distinguish between different types of gliomas, either before or after operation. Until tumors were classified and the life history of some of them worked out, there was no possibility of discriminating before operation between favorable and unfavorable cases. It was felt that every case of intracranial tumor called for an operation, and some still believe in following this rule today even in the case of the highly malignant cerebral glioblastoma multiforme and the cerebellar medulloblastoma.

Cairns' study of 157 patients with verified intracranial tumors operated upon in 1926-1927 by Dr. Cushing covers the pathological type of the tumor, its situation, and the condition of each patient seven to nine years after operation. Sixty-three patients were still alive and 37 of those were living useful lives.

The best late results were obtained in cerebellar astrocytomas, cholesteatomas, meningiomas, pituitary adenomas, and in a small proportion of acoustic neurinomas.

The illuminating "longest known survival" figures which Dr. Eisenhardt has added to Mr. Cairns' tables showing a four year survival for a glioblastoma and a seven year plus survival for a medulloblastoma makes one feel that in view of his inability to make an absolutely correct pre-operative pathological diagnosis, a surgeon is scarcely justified in refusing operation because a tumor is presumably malignant and the surgical exposure is known to have a high percentage of postoperative fatalities.

### RÔLE OF PRELIMINARY MEDICATION IN ANESTHESIA

PRELIMINARY medication has so developed that now it is a benefit to surgeons, obstetricians, patients, and especially to anesthetists. The patient is benefited by obtaining a good rest the night before the operation, his energy is conserved, and he is brought to the operating room far less fearful and apprehensive than formerly was possible without depressing his vitality. The wide clinical application of the barbiturates has resulted in the development of special preparations of them so that now specific results can be obtained. It is recognized that when these drugs are themselves not used to produce the anesthesia, fortunately the dose of the drug, rather than the method of administration is important. It has been found that the use of small doses of barbiturates, together with morphine and atropine, in preliminary medication, permit wider choice of anesthetic agents than was possible before the barbiturates came into use. If preliminary medication is given, patients do not complain much about the administration of local anesthetic

agents whether they are given for local spinal or regional anesthesia. In the field of local anesthesia the barbiturates are certainly the agents of choice for preliminary medication because they tend to neutralize one of the toxic effects of local anesthetic agents namely their tendency to cause convulsions. A further benefit in the use of the barbiturates is that they increase the tolerance of the patient for the epinephrine which is usually combined with the local anesthetic agent. Patients who are fearful and those whose fear continues for many hours preoperatively do not tolerate epinephrine well.

Since preliminary medication has been employed it has been possible to give gaseous anesthetic agents combined with amounts of ether smaller than were necessary before and ether when administered by the drop method can be used in smaller quantities. The anesthesiologist is able to produce anesthesia with quiet breathing and relaxation more quickly and more easily and without producing as profound a degree of narcosis. Other factors that help to accomplish these same results but which cannot be stressed here are the use of Magill's intratracheal tube, the use of balanced anesthesia which is the combination of small amounts of several anesthetic agents each given by an appropriate method and the use of tribromethyl alcohol in amylene hydrate (avertin) for basal anesthesia. Although this use of avertin might be considered under preliminary medication and its benefits are recognized it is not included in this discussion.

The barbiturates when administered at the proper time in labor have been of such benefit that they are very widely used. The obstetrician has found that small doses followed by administration of anesthetic agents have been beneficial in most cases. The greatest good for the greatest number has been brought about by the judicious use of drugs

that have borne part of the burden of placing the patient in a condition in which anesthesia or analgesia could be produced with a minimum of disturbance on the part of the patient and with a minimum of effort on the part of the anesthetist, the surgeon and the obstetrician.

Many drugs have been used for sedation and for the average person relatively inexpensive drugs are adequate. The fact that some of the more modern drugs are expensive is usually the argument given against prescribing them. Experience leads to the belief however that modern pharmaceutical chemists have kept pace with modern needs and that some recently developed drugs are definitely superior to older ones. There is a difference clinically in the effect of two barbiturates such as barbital and pentobarbital sodium and these differences must be kept in mind especially in the management of surgical patients. Relatively short periods of rest separated by periods of relative freedom from the effects of medication are invaluable to those in charge of the postoperative care of patients. Prolonged periods of sleep or unconsciousness might lead to confusion as to whether the sleep or unconsciousness was attributable to the prolonged action of a drug or to some new pathological condition.

The combined effect of a barbiturate and morphine is to reduce the minute volume of respiration and for that and other reasons such as the idiosyncrasy of certain individuals to certain drugs a routine dose should not be employed. The effect desired is quiet and freedom from fear but not inability of the patient to walk alone or to answer questions. If a general anesthetic agent is administered following heavy preliminary medication it is not uncommon for respiration to be greatly depressed before relaxation can be produced. Under such circumstances the surgical pro-

cedures may be interfered with. This is especially true when anesthesia is produced by administration of ether by the open drop method but depression of respiration is of much less importance when block anesthesia or local infiltration is combined with gas anesthesia. The use of atropine is of value when anesthesia is produced by inhalation. The dose, however, need not be large, for the average adult it is about 1/150 grain (0.0004 gram). It is especially useful when children are anesthetized, depending on their weight, they may tolerate a dose of 1/300 grain (0.0002 gram), which is a relatively greater dose for their size than that given to adults.

Aside from the hypnotic effect of barbi-

turates, there is recent experimental evidence which seems to corroborate clinical impressions that the onset of shock is usually delayed if barbiturates have been used. However barbiturates given preliminary to blood transfusion and to intravenous administration of solutions make the procedures easier for the recipients to tolerate and may minimize the untoward reactions. Recent work, also, has tended to show that the effects of particular anesthetic agents are especially influenced by particular kinds of preliminary medication and that, accordingly, the anesthetic agent and the method of its administration should be chosen with knowledge of what preliminary medication has been used. JOHN S. LUNDY

# MEMOIRS

## JOHN RIDLON

JOHN RIDLON was born in the township of Clarendon Rutland County Vermont on November 24 1852 He was one of three boys but the two others died in infancy His father Noel Potter Ridlon was a farmer who became a dairyman just before the Civil War His mother was Nancy Bromley Hulett Ridlon of Iawlet one of thirteen children Dr Ridlon always spoke highly of his Grandmother Ridlon whose husband died at the early age of fifty five and who with forty acres of land and about eight hundred dollars in money at interest raised eight children and five grandchildren

When John was fourteen his father was killed in a railway accident while driving home from Rutland The next year he and his mother left the farm for Poultney Vermont where he attended a commercial college Not long afterward they went to Marengo Illinois making the trip over the New York Central and Michigan Central railroads before the days of sleepers diners or even wash basins on the train At this time there came an opportunity to sell the Vermont farm which was supposed to contain marble and John and his mother were left in comfortable possession of about fifteen thousand dollars

During the next few years Ridlon worked at various times as book salesman grocery clerk and helper to a civil engineering corps His mother remained After contracting malaria and losing eighteen pounds in weight John returned to Vermont to attend the Vermont Central Institute and later Tufts College Through a miscarriage of college justice he was expelled from Tufts at the end of his sophomore year and so went to the University of Chicago graduating in 1875 An early indication of intellectual independence was his class oration on The Infallibility of the Pope its departure from orthodoxy creating a stir in that Baptist institution

At his various colleges Ridlon played baseball taught boxing and fencing organized a debating club started a library and pulled No 5 on the crew He also played bass viol in the orchestra and became a member of Theta Delta Chi Delta Kappa Epsilon and other college societies In 1899 he was recalled to Tufts to receive an Honorary M A degree and again in 1906 to be awarded the degree of Sc B

In 1875 Ridlon entered the College of Physicians and Surgeons in New York with Prof F G Seguin as his preceptor When he graduated March 1 1878 he





*John Ridgway*



was Class Marshal. He obtained a staff position at St. Luke's Hospital in New York, serving as house officer for two years. On June 4, 1879, he married Emily Caroline Robinson of Newport, Rhode Island. Mrs. Ridlon's father was a sea captain of many years' service. From him they inherited the home at No. 1 Sea View Avenue in Newport where were spent the last years of Dr. Ridlon's life.

Dr. Ridlon left St. Luke's Hospital in 1880 at the time their first child was born. For the next two years he was in general practice at 152nd Street and St. Nicholas Avenue. In 1880 also he received his first orthopedic appointment as assistant to Dr. Newton M. Shaffer at St. Luke's Hospital, going later to the New York Orthopedic Hospital and Dispensary.

Dr. Ridlon was one of the first in America to be attracted to the work of Hugh Owen Thomas in Liverpool. He went to see Thomas' work first hand, and became one of his very few close friends and a lifelong friend and associate of Thomas' nephew and successor, Sir Robert Jones. When Dr. Ridlon visited Mr. Thomas first he expressed skepticism as to the results claimed for the Thomas traction splints in hip, knee, and ankle disease. Mr. Thomas was able to convince him of their utility and efficiency, however, and Dr. Ridlon became and remained the leading American exponent of Thomas' principles of treatment for diseases and injuries of the extremities. Thomas' splints and the principles he taught received world wide recognition during the World War and led to the saving of thousands of lives and limbs.

When Dr. Ridlon returned from Liverpool in 1887 he made and applied at St. Luke's Hospital the first Thomas hip splint ever to be used in this country for tuberculous hip disease. Dr. Shaffer ordered the splint removed but Dr. Ridlon refused to remove it on the ground that he was responsible for the welfare of the patient. At the end of his year's service Dr. Shaffer prevented his reappointment and Dr. Ridlon went with Dr. McBurney to the Vanderbilt Clinic. A little later, when Dr. Gibney was elected to a professorship which Dr. Ridlon had expected, he moved, in 1889, to Chicago. Concerning the New York controversy over the use of the Thomas splint, it is interesting to read in Dr. Judson's book (1905) "Flexion and abduction [in hip disease] are rapidly reduced by the use of Mr. Thomas' hip splint in the skillful hands of Dr. Ridlon."

In June, 1890, Dr. Ridlon returned to Europe to assist in the organization of an orthopedic section of the International Medical Congress. He called upon Grattan (of the osteoclast) at Cork, Thomas and Jones at Liverpool, George Arthur Wright at Manchester, Florian Beely of Berlin, and many others. Dr. Ridlon and T. L. Stedman of New York had been commissioned by the *New York Medical Record* to report the Congress. Dr. Ridlon gathered the news while Dr. Stedman, from his room at the Kaiserhof Hotel, cabled fifteen thousand words to New York, thus "scooping" all other American medical journals by two weeks.

When Dr Ridlon came to Chicago in 1889 he was made instructor in orthopedic surgery at Northwestern University by Dr A S Davis I A year later he was made professor and served for sixteen years Subsequently he was professor at Rush for three years professor and secretary of the faculty at the Woman's Medical College for three years orthopedic surgeon at St Luke's Hospital for ten years and attending orthopedic surgeon for a time at Michael Reese Hospital He organized the orthopedic services of the Evanston Hospital and the Home for Destitute Crippled Children He was chief surgeon at the latter institution for twenty years leaving there with regret and a tinge of bitterness at being displaced by younger men At the time of his retirement however he was made consultant and life member of the corporation

Dr Ridlon was a charter member of the American Orthopedic Association (1887) At its tenth meeting he was president In his presidential address he called attention to the presence of fifty two members from sixteen cities and spoke of the value to the association of having not only those from the larger centers with abundant opportunities to see but of having also those from the smaller towns who had time to think It is significant that among those from the smaller towns at that meeting were Gillette of St Paul Griffith of Kansas City Moore of Minneapolis Lackard from Denver Sherman from San Francisco Steele from St Louis and Weigel from Rochester all of whom have placed their names permanently upon the roll of honor in orthopedic surgery

That Dr Ridlon dominated the affairs of the American Orthopedic Association for many years was not only charged by others but admitted by himself Indeed he said When I returned from the International Medical Congress (in 1890) I rushed back to New York to be in time for the meeting in Philadelphia DeForest Willard was president and George F Ryan was secretary I proceeded to elect A B Judson as president and myself as secretary At that time the secretary was also treasurer and editor of the *Transactions* I served as secretary for sixteen years and one year as president I was counted as Boss of the Association because I elected every officer except Weigel during that time Dr Ridlon later completed the unexpired war terms as secretary for Ralph Fitch of Buffalo in 1915 and for the winter in 1918

For several years Dr Ridlon served on the editorial staff of SURGERY GYNECOLOGY AND OBSTETRICS and did much to assist the staff in building up the journal

At sixty five Dr Ridlon reported September 27 1917 for active military duty at Fort Benjamin Harrison He had already joined the Medical Reserve Corps in 1909 and had attended a Plattsburg Medical Training Camp in 1916 During his military service Dr Ridlon was instructor and inspector in orthopedic surgery at various forts and camps finally becoming instructor in the Army Medical School from which he was honorably discharged February 8 1919 Later he joined the Public Health Reserve serving at the U S Marine Hospital and later

at the Veterans Hospital from which he was transferred to the Edward Hines Jr Hospital in Chicago when that institution was established

One of Dr Ridlon's outstanding characteristics was his generosity both professionally and financially to younger men. There was never a time when he would not give his energy or his money to assist especially one who was disposed to devote himself to the study and practice of orthopedic surgery. Many of the men of rising prominence in the middle west and even the far west have been Dr Ridlon's students in orthopedic surgery, a number having been undergraduates during his professorship at Northwestern University.

In 1923 it was the privilege and pleasure of this group of students and a few other friends of Dr Ridlon to gather in Chicago and to present to him and Mrs Ridlon the fine portrait painted by Mr Carl Bohnen which hangs in the Archibald Church Library of Northwestern University Medical School. At the close of the presentation exercises, Dr Ridlon remarked that he realized for the first time that he had always had what he knew he had always wanted, namely, the friendship and regard of the men whom he had looked upon somewhat too formally as students and professional colleagues.

After 1928 Dr Ridlon retired from practice in Chicago to make his home at Newport, Rhode Island. Even as he approached eighty years of age, however, he remained active. During 1931 he conducted an inspection of the school children of Newport for physical defects. He traveled to meetings of his orthopedic associates in Boston, New York, and elsewhere, and in 1933 was guest of honor at the Washington, D C meeting of the American Orthopedic Association under the presidency of Dr Arthur Steindler. For several years he applied himself almost daily to typewriting notes regarding the personalities and surgical experiences of his earlier days. He kept alive an extensive correspondence with many of the men in orthopedic practice in whom he always maintained a keen personal and professional interest.

When he left Chicago, Dr Ridlon distributed a small but choice collection of books on the history and practice of orthopedic surgery. Many of these are to be found now in the special collection accumulating under the direction of the writer in the library of the American College of Surgeons in Chicago. The forthcoming catalogue of this collection will contain many references to Dr Ridlon and many quotations from his letters and conversations.

Dr Ridlon's patients, pupils, and professional contemporaries will always hold him in high esteem. His devotion to his specialty and his ideals for the care of his patients were often expressed in criticism of those who fell short of his standards. Those who profited by his teaching and by the example of his methods, however, cannot but feel that they are much the better for his guidance, for his industry, and for his constant inspiration.

H WINNETT ORR



# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE book by Taussig<sup>1</sup> is one of a series of monographs dealing with the medical aspects of human fertility. It is sponsored by the National Committee on Maternal Health and represents a comprehensive review of the entire subject, its expressed purpose is to afford physicians, sociologists, and students of public health the facts needed to understand the ill effects of abortion on the physical well-being and moral integrity of the community.

The author has divided the material under four general headings (1) history and background, (2) spontaneous abortion, (3) induced abortion, (4) social aspects of abortion. Included in the first section is an interesting chapter on abortion in domestic animals, prepared by W. L. Williams, in which comparable conditions in etiology to those in the human are described.

In the United States, it is estimated that about 681,600 abortions occur annually, in proportions of 1 to 25 births in urban, and 1 to 5 births in rural districts. Taussig points out that as a result of abortions, about 8,000 to 10,000 women die each year and many more are disabled by septic sequelæ. This mortality and morbidity is due largely to the fact that so large a proportion of abortions are induced illegally under most unfavorable conditions. In contrast, he cites the results of legalized abortions as performed in the United States of Soviet Russia. A chapter is devoted to "Legalized Abortion in the Soviet Union" and the author states, "No book on the abortion written today can be complete without special consideration of the movement in Soviet Russia to legalize abortion." Under this plan, there were about 91,000 abortions performed in Moscow alone during 1931 with a death rate of only 1 in 10,000. In the past 4 years, however, they have noted the frequent occurrence of serious sequelæ—puerperal infections, endocrine and menstrual disturbances, ectopic pregnancy, sterility, and functional neuroses. As a result of the realization of this undesirable aftermath, a determined effort is now being made by the Soviet physicians to decrease the incidence of abortions and to encourage birth control, facilities for contraceptive advice being offered in organized "Prophylactariums." The Russian experiment has indeed furnished much food for thought.

In the chapter on the treatment of abortion, a review of the literature and an evaluation of results

obtained in various countries is clearly interpreted. The conservative versus the radical surgical treatment is fully and fairly discussed by the author. The book is splendidly written, well illustrated, and is free from errors. It is, indeed, a most valuable monograph which will doubtlessly be widely read by physicians in all fields of medicine.

IRVING F. STEIN

A SECOND edition in three years speaks for the excellence of *Electrotherapy and Light Therapy* by Kovacs. The book has been thoroughly revised, most of the new material is from laboratory and experimental observations.

The first two parts of this book present the physics of the different electrical currents, consider the apparatus for their production, explain their action on the body, describe the technique of their application, the indications and contra-indications for their use, and the possible dangers involved. Kovacs points out that the regulation of dosage in short-wave diathermy is at present an even more empirical procedure than in ordinary diathermy. Although the author indicates in several places that the reports of Schliephake await corroboration by competent observers, the conditions in which Schliephake obtained favorable results are enumerated. These claims contain such statements as "In purulent processes in the chest, purulent pneumonias, pulmonary abscesses and gangrene, pleural empyemas, complete resorption of the pus was effected in three to four weeks without any surgery." As this book is for students and general practitioners it would seem that such optimistic claims could be omitted.

In part three the physics of radiant energy, the effects of infra-red, luminous, and ultraviolet radiation, the clinical application of heliotherapy and the artificial sources of radiation are carefully considered. There is a complete discussion of the sources of ultra-violet radiation. It considers the newer sources of artificial radiation, the cold quartz and electrodeless high-frequency induction lamps, and notes that so far no clinical reports of results with controls have been published.

Part four is devoted to applied electrotherapy and light therapy in internal medical conditions, chronic arthritis, fibrositis, affections of the nervous system, bones, joints, muscle and tendons, in gynecological, genito-urinary and proctological conditions. The chapter on dermatological conditions is by Dr.

<sup>1</sup>ELECTROTHERAPY AND LIGHT THERAPY By Richard Kovacs, M.D.  
2d ed Philadelphia T. C. & F. E. 1935

<sup>1</sup>ABORTION SPONTANEOUS AND INDUCED MEDICAL AND SOCIAL ASPECTS By Frederick J. Taussig M.D. F.A.C.S. St. Louis The C. V. Mosby Co. 1936

Joseph J Eller diseases on ear nose and throat by Dr Wallace Morrison

This book can be recommended as the best text book on electrotherapy J S Coulter

THE second part of the second half of the fourth volume of Stoeckel's *Handbuch der Gynaekologie* devotes eleven hundred pages to the roentgen treatment of malignant tumors. This volume like the first half which dealt with non malignant tumors is encyclopedic in character. It contains over two hundred pages of finely printed references of the entire world literature.

This work is open to the same criticisms which were voiced in connection with the first half of the work which was written by the same authors. Wintz and Wittenbeck have made the work most cumbersome by virtue of the fact that it is too all inclusive. The section on the methods of technique include all of the methods used in the major clinics of the world. Thus valuable space has been devoted to a tiresome and endless repetition of methods many of which are antiquated and have been discarded. This attempt to make each section his-

torically and referentially complete makes the volume too ponderous for practical use. It loses its value even as an encyclopedia and reference work. RALPH A REIS

IN his volume devoted to war injuries Carl Franz discusses the following subjects: shock and collapse; injuries of the soft parts; suppurative and putrefactive wound infection; injuries of arteries and sites for ligation; injuries of peripheral nerves and the central nervous system; injuries of joints; the technique of joint resection and disarticulation; gunshot fractures; injuries of the scalp; skull face, mouth and eyes; injuries of the thoracic cage and abdomen.

It is obvious of course that the author does not intend this book as an exhaustive treatise on traumatic surgery or as a source of detailed instruction in the care of compound injuries of plastic or neurologic surgery which of course it certainly is not. To the uninitiated it offers a rather picturesque view of war surgery—its natural difficulties and failures—and above all the sad demonstrations of surgical situations that result from the battlefield. J R. BUCHHEIM, Jr.

By D Carl Franz M.D. d d 1  
Baltimore J. B. Lippincott 936

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Books received at the clinic of the department of surgery in the Johns Hopkins Hospital. By Julius L. Spack, M.D., Chas. S. B. Debo, 1936.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Richard M. H. Wright, B.A. M.A. M.D. LL.D. G.I. It is a book of 111 pages. London: W. B. Saunders Co., 1936.

DIE NACHHESSUNG DER VERLETZUNGEN DER KNOCHEN. By Prof. Dr. F. W. Reck, 1936.

THE EXTRA-OCULAR MUSCLES: A CLINICAL STUDY OF NORMAL AND ABNORMAL MOTILITY. By L. H. C. I. ter A. M. M. D. Sc. D. Th. H. L. P. H. L. C. & F. B. G. 1936.

UROLOGY IN WOMEN: A HANDBOOK OF UROLOGICAL DISEASES IN THE FEMALE SEX. By F. Cath. Lew.

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THE VASCULAR EXERCISES AND THE CO-OPERATIVE MANAGEMENT OF OBSTRUCTIVE VASCULAR DISEASES OF THE EXTREMITIES. By L. G. H. H. H. H. M. D. W. H. F. d by M. O. R. R. d M. D. H. L. d. L. P. H. d. L. d. J. B. L. P. P. C. O. C. 936.

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EUGENE H POOL, New York, *President-Elect*  
Secretary, *Committee on Arrangements*

## THE 1936 CLINICAL CONGRESS IN PHILADELPHIA

### EVENING MEETINGS

The Executive Committee of the Board of Regents is preparing programs for the five evening scientific sessions to be held in Irvine Hall. At the presidential meeting on Monday evening, the first formal session of the Congress, Dr Donald C Balfour, the retiring president, will deliver an address, and Sir James Walton, of London, England, will give the second annual oration on surgery. At this session the new officers will be inaugurated. Dr Eugene H Pool, New York, president, Dr Emile Holman, San Francisco, and Dr George E Wilson, Toronto, vice-presidents. Dr Eugene H Pool will deliver the presidential address at the convocation of the College on Friday evening on which occasion the 1936 class of initiates will be received into Fellowship. At sessions on Tuesday, Wednesday and Thursday evenings eminent surgeons of the United States and Canada with visiting surgeons from foreign countries will present papers on surgical subjects of present day importance. Among papers to be presented are the following

The Treatment of Coronary Sclerosis and Angina Pectoris by Grafting a New Blood Supply to the Myocardium  
CLAUDE S BECK, Cleveland  
Treatment of Fracture of the Neck of the Femur by Internal Fixation  
M N SMITH-PETERSEN, Boston  
Injuries of the Bones and Soft Tissues of the Face  
VILLY P BLAIR, St. Louis  
Rationalizing Treatment in Acute Intestinal Obstruction  
OWEN H WANGENSTEEN, Minneapolis  
Chronic Intestinal Obstruction Due to Lesions of the Large Bowel  
VERNON C DAVID, Chicago  
The Combined Spleen Clinic Results with Medical and Surgical Therapy in Splenopathies  
ALLEN O WHIPPLE, New York  
Fracture Oration The Essential Features of Fractures of the Shoulder  
GEORGE E WILSON, Toronto  
The Management of Severe Hyperthyroidism  
FRANK H LAHEZ, Boston  
Transurethral Surgery, Its Indications, Limitations and Complications  
HERMON C BUMPUS, JR, Pasadena  
Title to be selected  
WILLIAM F RIENHOFF, JR, Baltimore

THE surgeons of Philadelphia are planning largely for the twenty-sixth annual Clinical Congress of the American College of Surgeons to be held in that great medical center October 19-23, 1936. They will present a program of surgical clinics and demonstrations that will provide a complete showing of their clinical activities in all departments of surgery. The Committee on Arrangements is assured of the hearty co-operation of the clinicians at the five medical schools and more than thirty hospitals participating in the clinical program.

A preliminary clinical program was published in the June issue of this journal and the Bulletin of the College and will be republished in the August issue. The clinical program is to be further revised and amplified during the coming months as the work of the program committee progresses. Operative clinics and demonstrations in the hospitals are scheduled for the afternoon of Monday, October 19, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days. All departments of surgery will be represented therein—general surgery, gynecology and obstetrics, genito-urinary surgery, neurosurgery, orthopedics and surgery of the eye, ear, nose and throat.

The Committee plans to develop many special features in the clinical program including (1) Cancer clinics demonstrating the treatment of cancer by surgery, radium and x-ray, (2) fracture clinics demonstrating modern methods in the treatment of fractures, (3) clinics in traumatic surgery presenting the newer methods of rehabilitation of the injured by surgery and physical therapy.

An extensive schedule of operative clinics and demonstrations at the hospitals that will be of particular interest to those who specialize in surgery of the eye, ear, nose and throat is being prepared by the sub-committee on ophthalmology and otolaryngology.

At this year's Congress we will be honored by the presence of a number of distinguished foreign surgeons. Among those who will attend are the following: William F. Shaw, Manchester, England; Archibald H. McIndoe, London, England; J. P. Lockhart Mummery, London, England; Alexander MacLennan, Glasgow, Scotland; Josef Halban, Vienna, Austria; Alan Newton, Melbourne, Australia; Paul Clairmont, Zurich, Switzerland; Martin Kirschner, Heidelberg, Germany; Wolfgang Rosenthal, Leipzig, Germany; Dr. F. Sauerbruch, Berlin, Germany; and Rodolfo E. Pasman, Buenos Aires, Argentina.

#### SPECIAL FEATURES OF THE PROGRAM

Special features of the program for this year's Congress include: (1) A conference on fractures under the auspices of the Committee on Fractures; (2) a symposium on cancer arranged by the Committee on the Treatment of Malignant Diseases; (3) a conference on industrial medicine and traumatic surgery under the auspices of the Committee on Industrial Medicine and Traumatic Surgery.

The showing of surgical motion pictures demonstrating clinical features of interest has met with popular acceptance in recent years and will be continued at this year's Congress with an enlarged program of films, both sound and silent, to be exhibited daily at headquarters.

#### HOSPITAL CONFERENCE

The annual hospital conference will open the Congress with a session in the Rose Garden of the Bellevue Stratford Hotel at 10 o'clock on Monday morning. An interesting program of papers, round table conferences and practical demonstrations dealing with problems related to hospital efficiency is being prepared for sessions on Monday, Tuesday, Wednesday and Thursday. It is proposed to make this year's program of wide interest and practical character through a careful selection of subjects to be presented and discussed by surgeons and hospital executives; particular emphasis is being directed toward professional standards and the vital problems related to hospital economics.

#### HEADQUARTERS—TECHNICAL EXHIBITION

Clinical Congress headquarters will be established at the Bellevue Stratford Hotel, which has unusual facilities for accommodating the Congress. The grand ballroom, Garden, Clover and

Red Rooms and other large rooms on the first and second floors and the roof have been reserved for scientific sessions and conferences, registration and clinic ticket bureaus, bulletin boards, executive offices, etc. Thus the activities of the Congress will be centralized under one roof.

The Technical Exhibition will be located in the ballroom and adjacent large rooms on the second floor. The registration and clinic ticket desk together with the information bureau will be centrally located as regards the exhibit rooms in which will be placed the bulletin boards on which the daily clinical program will be posted each afternoon. Leading manufacturers of surgical instruments and supplies, x-ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in this Exhibition.

#### ADVANCE REGISTRATION

The hospitals and medical schools of Philadelphia afford accommodations for a large number of visiting surgeons, but to insure against overcrowding attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that those surgeons who wish to attend the Congress will register in advance.

Admittance to all clinics and demonstrations will be controlled by means of special clinic tickets which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic is given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE MEASUREMENT OF THE HARMFULNESS OF DUSTS FOR HUMANS THROUGH THE AGENCY OF ANIMAL REACTIONS<sup>1</sup>

WITH SPECIAL REFERENCE TO THE LESIONS PRODUCED BY SILICA AS A BASIS OF COMPARISON

CAREY P. McCORD, M.D., CINCINNATI, OHIO

RICHARD L. FLEMING, HARRIET AINSLEE, and JAN JOHNSTON, DETROIT, MICHIGAN

Of all industrial dusts, only two lead to characteristic nodular fibrosis of the lungs. These are silica (silicon dioxide) and magnesium silicate, chiefly in the form of asbestos, but possibly including others, such as talc. With this decided limitation of the types of industrial dusts that serve as fibrogenetic agents, it might be assumed that dusty industries should present no difficulties in the determination of the harmfulness of the dusts to which exposure is provided. On the contrary, there are many dusty trades in which the nature of the dust is so uncertain, or so complex, that the extent of possible damage cannot be readily established. This situation may be best clarified through representative illustrations.

In the manufacture of glass, quartz silica is the major raw ingredient. As such, this constituent of glass is a prime source of silicosis, assuming prolonged exposure and fineness of particle size, but is it true that dust from glass produced by the heating of this silica with lesser ingredients will also produce silicosis?

In a coal mine the preponderant dust naturally is carbon, but admixed with it may be a dangerous but little known content of silica dust derived from the overburden of the coal seam.

Certain clays in their native state may contain a low percentage of free silica, such as 12 to 16 per cent, the remaining portion of the contained silicon being combined in the form of silicates. When such clays are shaped into objects and repeatedly fired at high temperatures, such as takes place in several branches of the ceramic industry, the free silica content may be increased to approximately 50 per cent, due to the action of repeated high temperatures breaking down the silicate molecule and liberating free and injurious silica.

Certain forms of silica do not exist as quartz, but in the amorphous state, such as characterizes diatomaceous earth, or in the cryptocrystalline form, such as characterizes tripoli. The physiological action of such substances is little known (1, 2).

Practical terminology of industry is such as to lend marked confusion in identifying the mineralogical nature of dusty substances. "Rouge" is a term more often applied to iron oxides, such as "red rouge," or "black rouge." These iron oxides are essentially harmless, but "white rouge" is not an iron oxide at all, but instead may contain silica in excess of 99 per cent. As used, this "white rouge" chiefly is comprised of particles in the size zone of danger to humans.

<sup>1</sup>From the Industrial Health Conservancy Laboratories Cincinnati, Ohio.

Lastly in this category of examples may be cited the fact that silica dust in the absence of association with certain other dusts may be distinctly more harmful than this same quantity of silica mingled with other dust particles such as from clay coal ferrous minerals etc. It is believed that some degree of protection against the action of silica in the body is rendered by the coexistence of these other dust forms. Manifestly the operations of industry are attended by so many variables as to alter the prospect of harm from produced dusts.

It is for reasons such as these cited that at times it becomes most difficult to appraise the extent of anticipated injury from the dusts found in any given industry. A highly useful purpose will be served if through any simple procedure the harmful properties of any dust may be established with reasonable certainty.

#### PROCEDURES AVAILABLE

To the uninitiated it might appear sufficient to carry out a quantitative chemical analysis. Such a procedure readily yields a figure accounting for the total percentage of silica. However ordinary chemical methods fail to distinguish between free silica which is the harmful agent and the combined silica present as silicates which with the exception of asbestos and possibly other forms of magnesium silicate is essentially harmless. Many a quantitative chemical analysis may show a total content of silica of such order as 65 per cent while the content of free silica may be as low as 5 per cent. The worth of quantitative chemical procedures at once becomes circumscribed in any quest for proliferative agents.

Free and combined silica may be distinguished by petrographic measures but the technical requirements are so difficult as to make the results of dubious value unless achieved by a highly skilled petrographer. Moreover the expense for this type of procedure is necessarily high.

The enumeration of dust particles by any method—that is light or dark field or photographic—may furnish valuable information as to the numerical quantity of dust present but wholly fails to distinguish between the different kinds of dust that exist at any specified work point.

After worker exposure has extended over a long number of years such as from 5 to 20 negative roentgenograms of the chest afford some but not necessarily unequivocal evidence of the absence of a harmful dust. Conversely the establishment of characteristic findings of silicosis or asbestosis in roentgen ray films constitutes acceptable proof of the presence of a harmful dust provided other exposures may be eliminated. The same quality of evidence presents itself in clinical cases of silicosis or asbestosis particularly when confirmed by autopsy successfully demonstrating the excessive presence of silica or asbestos in the lungs.

The detection of above normal quantities of silica in the urine constitutes proof of the exposure to silica in some fashion and comprises presumptive proof of industrial exposure if non industrial exposures may be negated. However the finding of silica in the urine affords no proof of an existing silicosis. Of like significance is the finding of asbestos bodies in the sputum which again constitutes proof of nothing more than exposure to asbestos. The absence of this finding does not eliminate the possibility of exposure to asbestos dusts.

Röntgen rays impinging upon particles of dust in the atmosphere are dispersed in characteristic fashion for each specific dust but probably not for mixed dusts. Thus identification is not exact.

At various times investigators have exposed animals to inhalations of suspected dusts and true silicotic lesions have appeared but unfortunately the time required for the development of such findings is comparable to that required to produce silicosis in man so that this method possesses obvious limitation.

Quick but somewhat inconclusive evidences of the harmful nature of dusts have been obtained by the implantation of suspected dusts into and beneath the skin and into the eye.

No one of the aforementioned procedures readily may be applied by the physician or laboratory worker as a quick test for the determination of the physiological action of a suspected dust. Lately Miller and Sayers have described a technique which because of ready responses and specificity of action may afford an acceptable method for the rapid ap-

praisal of the physiological responses to dusts. This test centers about the reactions to dust after the implantation within the peritoneal cavities of small animals. Certain changes other than the usual reaction to the presence of a foreign body may be noted within 1 week after injection, and commonly at the end of 30 days trustworthy differentiating readings may be made, although many experiments may require longer periods. The investigators mentioned state, "The tissue of the peritoneal cavity responds actively to dust introduced as a foreign body, and this response is of such character that it may be used as a basis for the classification of industrial dusts from a physiologic standpoint." The present investigation, making use of substantially the same technique as Miller and Sayers, confirms their results, extends the procedure to a number of dusts not examined by them in their series of inquiries, and seeks to promote this test as being readily applied and informative in the appraisal of the physiologic actions of dusts.

#### SUGGESTED PRACTICAL TECHNIQUE

The procedures shortly to be presented are not susceptible of general application. In many cases responses of tissues to the presence of dusts are such as to yield changes that may be properly interpreted through the inspection of gross specimens after only 30 days of exposure. Other dusts do not bring about the characteristic manifestation in so short a time and may require an exposure period of 60 or 90 days. While the macroscopic appearance is usually a reliable criterion, a small percentage of dusts tested may require microscopic examination prior to valid interpretation. Obviously the optimum procedure would make use of a fairly large number of animals, some of which would be killed off at intervals such as 7, 14, 30, 60, and 90 days, followed in all cases by a microscopic examination of the specimens obtained. Therefore, it is to be recognized that the procedure centering about a 30 day exposure period is the very minimum compatible with trustworthy interpretation made by experienced observers.

*Preparation of mineral suspensions.* The mineral or other chemical to be tested is screened through a 325 mesh sieve. Two grams of the material, care-

fully weighed, is placed in 40 cubic centimeters of physiologic saline, in a small Erlenmeyer flask, and plugged. A few glass beads should be added to facilitate suspension. This material is then sterilized by boiling or autoclaving. Losses through evaporation should be replaced by the addition of sterilized physiologic saline. Small traces of silica may be derived from the glass itself in the course of boiling, but for practical purposes this is negligible. In the hands of little experienced persons it is desirable that in making preparations for samples of dusts of unknown properties, other samples respectively be prepared of (1) a known quartz dust of high purity, (2) an inert substance such as titanium dioxide, carborundum or black rouge, and (3) an absorbable substance such as magnesium carbonate, gypsum or limestone. This step is introduced in order to have available suitable comparisons with the well known proliferative, inert, and absorptive reaction of the substances mentioned. The quantity of each of the suspensions prepared is sufficient for 20 animals, although it is unlikely that this number is called for in routine practice.

*Procedure with animals.* Healthy male guinea pigs are well suited for this test. Preferably the initial weight of such animals should be above 300 grams. No especial dietary requirements are necessary other than those in common usage. Just prior to injection a small area on the right side of the animal's belly well toward the pelvic region should be clipped, but not shaved. Immediately before injection this area should be painted with tincture of iodine, or equivalent.

*Injection procedure.* One-tenth gram of dry weight of the dust material appears to be better suited for routine procedure than two-tenths grams, inasmuch as the latter quantity in the case of some dusts of irritant qualities leads to a high mortality rate. Conversely, one-tenth gram provokes ample reaction for clear cut interpretations. This amount of material in 2 cubic centimeters of fluid is taken up into a sterile syringe, which ordinarily may be either of the plunger or bulb variety. A 20 gauge needle is usable. The dust suspension is deposited in the peritoneal cavity of the pig with due consideration for the prevention of trauma to the abdominal contents. Immediately after the injection all animals undergo a momentary period of mild convulsion, chiefly characterized by marked jerking of the limbs, running, and jumping. After injection, and in the absence of death, no action beyond customary care is requisite for a period of 30 days. However, for more elaborate inquiry, much may be gained if some animals are dispatched and examined after such periods as 5, 10, and 20 days, and if others are continued for longer periods such as 60, 90, or 120 days. Some variation in the number of animals to be injected depends upon the experience of the technician and the significance of the results desired. In the hands of an experienced investigator, 5 animals, all injected with an unknown dust, are sufficient to yield results that may be accurately interpreted.



Fig. Typical subcutaneous dust in male injected with glass dust. The photograph shows a typical reaction in the subcutaneous tissue of a male rat injected with glass dust. The reaction is characterized by a large, dark, irregular mass of dust particles, surrounded by a lighter, more organized tissue structure. A scale bar is visible at the bottom left, and the number '211' is printed vertically on the left side of the image.

**Procedures at autopsy.** Thirty days after injection the animals should be killed without the aid of chemicals. Since the chief lesions probably will be in the midline of the abdominal area and at the most dependent portion, the customary midline section should be replaced by a left-sided flap, which is just the reverse of that shown in Figure 1. This represents the practice of a left-handed person. On inspection of deposits or nodules characteristic of the substances studied may be found on the anterior peritoneal wall unless of such nature as to have been completely absorbed. Additional deposits or lesions at times may be found on the diaphragm, suspensory ligament, liver, gall bladder, omentum, mesentery, spleen, in testes, epididymis, seminal vesicles, cremasteric muscle, and on the posterior wall of the peritoneal cavity. Apart from the anterior abdominal wall the commoner sites are in order: the omentum, the epididymis, and the liver. The type and extent of the reaction constitutes the criteria for appraisal of the type of reaction that may be expected within the human lung, assuming adequate exposure. The

discussion of the varieties of responses constitutes a succeeding portion of this article. Until suitably qualified by experience, appraisal of the reaction of an unknown dust should be predicated upon direct comparison with known proliferative, inert, and absorptive reactions provoked by agents of known action.

#### TYPES OF REACTIONS

The reaction of peritoneal tissue upon the entry of dust is specific for the individual dust introduced. This specificity is not limited to the placing of specimens being tested into a classification with respect to physiologic action, but at least in some small degree every individual specimen tested presents minor peculiarities. Thus for example the tripoli obtained respectively from southern Illinois and southwestern Missouri may cause responses characteristic of silica in general and thus place these two specimens in the classification of proliferative agents, but in addition very minor differential points may distinguish the Missouri tripoli from that obtained from Illinois. Regardless of the nature of the dusts introduced, the immediate reaction is the same, being the response to the introduction of any foreign substance. Without secondary reaction, this irritation from a foreign body eventually results in encapsulation. In the work of Sayers and his associates, the secondary reactions are limited to three, namely: (1) the absorptive reaction, wherein the injected dust disappears from the tissues without the production of scar tissue; (2) the inert reaction, in which the injected dust remains approximately the same in amount throughout the period of observation, so that whatever nodules are produced are chiefly attributable to the injected substance itself rather than any tissue production; and (3) a proliferative reaction represented by nodules of newly formed tissue progressively increasing in size so long as the stimulating mineral remains undissolved. These investigators limited their readings to reactions on the anterior peritoneal wall. They however specify that the reactions on the abdominal viscera are the same. From our own experience it seems necessary to recognize two other forms of reaction in order to encompass the full scope of responses detected.

The first of these may be characterized as a mixed reaction. In a few of the 63 series of

examinations carried out, such substances were introduced as were known to represent appreciable contents of free silica mechanically mixed with a higher content of silicates and non-siliceous materials. Of such materials, special clays may be accepted as exemplary. On the anterior abdominal wall the noteworthy observable reaction was that of inertness. However, a few typical silicotic nodules were demonstrable here and there on the abdominal viscera, in most instances chiefly on the liver or genito-urinary organs. It is by no means remarkable that such a phenomenon should occur. The clays represent mechanical mixtures with silicates, together with other mineral compounds. The fact that small quantities of free silica may have become dislodged from the chief mass and may have imbedded themselves in nearby organs is not remarkable. These typical nodules of silicosis may coexist in the same animal with inert deposits transported by phagocytes, or otherwise, to such tissues as the omentum, the epididymis, the intestines, etc.

The second of our added reactions may be designated as "miliary-proliferative." It has been noted that certain dusty substances resulting from industrial practices represent in addition to proliferative agents such as silica, other agents that may possess more irritant properties. When such a dust is introduced into the peritoneal cavity it appears that the irritant component of the dust incites such marked movement of the intestines, seminal vesicles, and omentum that dust that ordinarily might be expected to settle by gravity to the pendent abdominal wall is instead distributed throughout the abdominal cavity. This reaction is not the result of the solution of silica or other proliferative agents, followed by the transportation of these soluble products to other portions of the abdominal cavity, nor is it the result of transportation by phagocytes or other cells. Rather, the mechanism appears to be the result of mechanical transportation resulting from the turmoil of organ movement when incited by the presence of irritants. At least it is possible to observe during the first few days after peritoneal injection small masses of dusts being moved about by organs in motion. Apparently wherever particles of



Fig 2 Massive silicotic nodules in animal injected with  $\frac{1}{10}$  gram quartz silica, with particle size 5 microns or less, plus  $\frac{1}{10}$  gram of sodium bicarbonate. Only a few miliary nodules discernible in photograph.

dust are deposited, a proliferative response arises, if in fact the dust transported be of proliferative nature. So magnified is the quantity of involvement that under these circumstances it becomes necessary to draw some distinction between ordinary proliferation at the site of injection and this miliary proliferation almost everywhere present throughout the tissues of the abdomen.

The significant reaction is of course that of proliferation. Those dusts entering the lungs that are not toxic in the sense that lead or arsenic is toxic, and further are without the property of creating fibrotic tissue, naturally are harmless, or essentially so. In short, the proliferative reactions are positive. The inert and absorptive reactions are negative. Since the silicotic nodule is the prime item of concern, it is desirable that a brief description of it be given.

As seen on the anterior abdominal wall after peritoneal injection at the end of 30 days the silicotic nodule when stimulated by quartz silica is of a cream color at once suggesting the presence of fat or lipoidal material. In the absence of adhesions the nodule presents shiny smooth elevated contours with the surfaces well injected with newly formed blood vessels. The size ranges from a pin head to a hazel nut or may be flattened to resemble an almond in size and shape. As ordinarily encountered the nodules are confluent with many others so that the mass that is present may become lobulated.

On section of the larger nodules a beginning necrosis may at times be observed suggesting a sterile abscess or may evince signs of calcification. The presence of granules of undissolved silica may be detected weeks after injection. The silicotic nodule is unique in structure and maintains its integrity in not partaking of the cellular characteristics of the organ in which it is implanted. Secondary nodules present an endless monotony as to structure regardless of their situation. Microscopically the silica nodule at the end of 30 days is chiefly made up of aggregations of phagocytes or macrocytes nearly all with a content of silica particles of varying sizes. The presence of these cells represents no inflammatory reaction although the attraction to the point of silica deposits possibly centers about irritant properties of soluble derivatives of silica. It is to be understood that the process through which the silica nodule is produced on the abdominal wall is dissimilar to that for the production of the silicotic nodule within the pulmonary tissue. In the former the phagocytes and other cells containing silica do not migrate to nearby masses of lymphoid tissue. The greater number remain near the point of injection of the silica particles.

In time these nodules undergo necrosis and break down in a fashion similar to a true tubercle. Calcium deposits may take place in the decomposed areas. Some hyalinization may take place throughout the nodule as time elapses but little is observed at the end of 30 days. An able description of the silicotic nodule as found in the lung is presented by Gardner.

In the interpretation of findings following the implantation of dusty materials in the peritoneal cavity prime consideration should be attached to the presence or absence of typical silicotic nodules as a result of the proliferative action of silica and certain other substance containing silica. These nodules tend to increase in size week by week over an indefinite period of time up to about 90 days while the lesions of the reaction of inertness progressively diminish and may entirely disappear.

#### REPRESENTATIVE RESPONSES

Our series embraces 29 individual mineral and chemicals. However a total of 63 different series of experiments were conducted owing to the use of the substances in different sized particles through mixtures of two or more substances as a result of the use of the same type of substances but derived from different sources and through the injection of varying amounts. In some series 20 to 30 animals were utilized but in the majority the number of animals was from 2 to 10.

The interpretations placed upon the findings made are shown in Table I. In this table there are likewise included the interpretation of Miller and Sayers from their series of experiments. In each instance the Miller and Sayers items are indicated by (S). The intent in including the Miller and Sayers material is to assemble in one tabulation all of the available interpretations thus far made as a result of this type of investigation.

#### EVALUATION OF STUDY

The fact that distinct proliferative reactions may be obtained after peritoneal injections from all high silica specimens does not necessarily mean that unfailingly all of these same materials may induce clinical silicosis in humans. Two types of exceptions are noted. Silica of particle size incapable of entering the air sacs of the lung will produce a proliferative reaction in the abdomen. If industrial exposure were limited to these same particle size ranges silicosis would not be produced. Tripoli which is crypto-crystalline silica or possibly crypto-crystalline and amorphous silica combined readily produces proliferation in animals but rarely produces clinical silicosis.



owing to limited dust formation. For such reasons this laboratory test should be interpreted with due regard for the totality of factors influencing the probable occurrence of pulmonary silicosis.

Wherever quartz, crypto-crystalline, or amorphous silica is injected into animals along with alkali substances, such as sodium bicarbonate, sodium carbonate, magnesium carbonate, or magnesium oxide, the tissue responses are much accelerated. This is of especial significance because of the emphasis that has been placed upon "acute silicosis" associated with some industries, such as the manufacture

of abrasive soaps. Injections of animals, using 0.2 gram of silica plus the proper combining weight of any of these mentioned substances, are followed by a high mortality. This is true although the injection of the silica or the alkali alone (sodium carbonate excepted) is unassociated with the prompt death of the animals. For this reason the quantity of silica was limited to one-tenth of a gram and was admixed with chemically combining portions of alkalis. Under such circumstances the animals ordinarily survived, but the proliferation was much more active and extensive than from the silica alone. The high mortality en-

TABLE I—PHYSIOLOGIC REACTIONS TO DUSTS

Proliferative <sup>1</sup>	Inert <sup>1</sup>	Absorptive <sup>1</sup>	Mixed <sup>1</sup>	Miliary Proliferative <sup>1</sup>
Chat (S)*	Anthracite coal (S)*	Calcite (S)*	Bentonite <sup>13</sup>	Silica plus sodium bicarbonate <sup>23</sup>
Diatomaceous earth <sup>2</sup>	Ball clay <sup>1</sup>	Calcium carbonate (precipitated) (S)*	China clay (kaolin) <sup>13</sup>	Silica plus china clay plus sodium bicarbonate <sup>23</sup>
Flint (S)*	Bituminous coal (S)*	Gypsum (S)*	Fire clay <sup>1</sup>	Silica plus magnesium carbonate <sup>7</sup>
Quartz (S)*	Black rouge <sup>8</sup>	Limestone (S)*	Granite <sup>23</sup>	
Silica (quartz various types and sources) <sup>2</sup>	Carborundum (S)*	Magnesium carbonate <sup>12</sup>	Slate flour <sup>4</sup>	
Silica (amorphous) <sup>1</sup>	Cullet (glass) <sup>9</sup>	Portland cement (S)*		
Silica (amorphous) plus limestone <sup>2</sup>	Class batch <sup>23</sup>	Silica gel <sup>10</sup>		
Silica plus china clay <sup>4</sup>	Lead sulphate <sup>10</sup>	Silica gel plus sodium carbonate		
Silica (white rouge)	Precipitator ash (S)*	Silica gel plus sodium bicarbonate		
Tripol <sup>14</sup>	Red silica (jeffers rouge ferric oxide) (S)	Sodium bicarbonate <sup>14</sup>		
	Soap stone (S)*	Sodium carbonate <sup>14</sup>		
	Titanium dioxide <sup>11</sup>	Sodium silicate <sup>14</sup>		

For physical and chemical properties of dusts injected by Miller and Sayers: see Public Health Report 1934, 39. So

<sup>1</sup> Unless otherwise specified size particles of dust injected was 42 microns or less with numerical preponderance below 5 microns.

<sup>2</sup> Amorphous silica silicified marine algae silica content approximately 99 per cent.

<sup>3</sup> Several sources sizes including one below 5 micron. Silica content always above 99 per cent.

<sup>4</sup> Free silica content 94.37 per cent. One specimen 100 per cent through 600 mesh screen, another air floated with particles below 5 microns.

<sup>5</sup> Two tenths gram each.

<sup>6</sup> White rouge 99 per cent silica—china clay mixed silicates with approximately 5 per cent free silica one tenth gram each.

<sup>7</sup> Silica content 99 per cent air floated.

<sup>8</sup> Crypto-crystalline silica Seneca type one specimen with particle size below 5 microns. Free silica 97.3 per cent.

<sup>9</sup> Ferrous ferric oxide, FeO.

<sup>10</sup> PbSO<sub>4</sub>.

<sup>11</sup> TiO<sub>2</sub>.

<sup>12</sup> Total impurities less than 0.4 per cent.

<sup>13</sup> H<sub>2</sub>SiO<sub>3</sub>. Two specimens used one air floated with particle size below 5 microns.

<sup>14</sup> NaHCO<sub>3</sub>. Total impurities 0.046 per cent.

<sup>15</sup> Na<sub>2</sub>CO<sub>3</sub>. High mortality rate from irritative properties. Total impurities 0.033 per cent.

<sup>16</sup> Approximately Na<sub>2</sub>SiO<sub>3</sub> injected in solution.

<sup>17</sup> Free silica content circa 5 per cent.

<sup>18</sup> Non refractory colloidal clay probably formed from volcanic rock.

<sup>19</sup> Kaolin. Free silica content circa 5 per cent.

<sup>20</sup> Cr and trap glass multi colored. Exact chemistry unknown. Chiefly composed of silicates.

<sup>21</sup> Two varieties employed. Free silica content 90 to 95 per cent.

<sup>22</sup> All constituents of plate glass including silica, limestone, soda ash, iron oxide, salt cake. Specimen not screened in order to preserve the color.

<sup>23</sup> Variety of make up. Specimen taken from dust collector. Exact constituency uncertain.

<sup>24</sup> Consists chiefly of quartz, feldspar, mica and hematite. Approximate silica content 35 per cent.

<sup>25</sup> Approximate content of free silica 5 per cent.

<sup>26</sup> High mortality rate whenever these substances injected subcutaneously either in equal quantities or in combining weights.

<sup>27</sup> One tenth gram of each.

<sup>28</sup> Injected in combining quantities two tenths gram of silica being employed.

countered when two substances are injected simultaneously whereas individual injections are relatively innocuous suggests an enhanced toxicity due to chemical reaction. Mixture of silica with other types of alkali substances such as limestone have not induced any increased proliferation. The influence of alkalis upon the action of silica is believed not to constitute proof of the acceleration of silica action in the lungs by alkali substances and at the present time the marked increase of tissue response within the peritoneal cavity as a secondary reaction is attributed chiefly to the wider distribution of silica due to increased motion of some of the organs within the abdominal cavity.

Throughout this series of experiments adhesions have been encountered but these have not been associated in distinct fashion with any class of substances. Those materials that are absorbed rarely led to adhesions. Conversely those combinations of dust that led to multiplicative proliferative responses are almost invariably associated with adhesions. Whenever coils of intestines or seminal vesicles or omentum are closely bound to the abdominal wall in connection with proliferative action the number and distribution of nodules is ordinarily increased.

In this experimental work as repeatedly indicated in this article the nodules or other evidences of physiologic responses have in many instances been widely distributed appearing almost without exception on all organs. The literature with respect to the appearance of nodules apart from the point of initial location of the silica is far from uniform in its contentions. Certain investigators maintain that silica particles are dissolved and that the solute is transported to various points favorable to the development of secondary nodules. Others contend that solid particles of the silica are transported and that these particles are necessary for the formation of the nodules. Whatever may be the facts in pulmonary silicosis it is clearly manifest in the type of experimental silicosis herein described that actual particles of the silica or other injected agent are transported as such to the site of the new lesion formation. While this may not be the infallible rule this process occurs in the

majority of instances within our experience.

On the omentum in particular it has been noted that alongside of typical silicotic proliferative areas tiny areas of mineral may be deposited. These areas smaller than a pin head in size may be as numerous as 20 or 30 in one omentum and may be interspersed in about an equal number of characteristic nodules. To all appearances these mineralized areas represent small masses of injected silica that for some unknown reason have not been able to provoke characteristic proliferative reaction.

Those dusty materials classified as inert and absorptive by no means uniformly settle to the pendent portion of the anterior abdominal wall or in the case of absorptive materials immediately disappear. Silica gel which is classed as an absorptive agent possesses a bronze color. This characteristic color may be detected in practically all organs of the abdominal cavity. Characteristically colored areas may be found on the epididymides the cremasteric muscles and over the intestinal tract a tinge of characteristic color is discernible.

In general it appears that the method here utilized affords some promise as a method for the prompt determination of the type of reaction that may be expected in human beings after extensive exposure in industrial pursuits.

#### SUMMARY

The introduction of dusts in suspension into the peritoneal cavities of animals provokes prompt responses indicative of or at least suggestive of expectable reactions in the lungs of human beings after effective exposures. Thirty days after injections are made it is frequently possible to interpret the physiologic action of any given dust in relation to tissue proliferation. Preferably the period of exposure should be extended to 60 or 90 days and should be associated with microscopic tissue examination. The responses encountered are essentially specific for individual minerals.

Utilizing the Miller and Sayers technique 63 series of examinations have been carried out utilizing guinea pigs as the test animal. The responses obtained in animals for all dusts are in keeping with accepted concepts of the action of these respective dusts on workers.

exposed in industry The admixture of mild alkalis, such as sodium bicarbonate, with silica in any of its forms markedly increased the number and distribution of the silicotic nodules

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THE RESPONSE OF THE MAMMARY GLAND TO PROLONGED STIMULATION WITH OVARIAN HORMONES<sup>1</sup>

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THE early part of this century saw the first convincing evidence by ovarian transplants and extracts in castrated animals that the breast depended upon the ovaries for its development (Fuller Aschner, Frank Rosenbloom, Loewe). It is now apparent that the successive phases of pubertal development, pregnancy, lactation and post-climacteric quiescence are all regulated by hormonal action. The chief agents in this endocrine control are certain pituitary and ovarian hormones. Lewis and Geschickter conclude that each of the two accepted ovarian hormones evoke peptic benign lesions of the breast. Cystic disease of the breast is thus said to be the result of overstimulation with estrin (theelin) while the acinar hyperplasias (adenosis) are ascribed to progesterin (corpus luteum) effect. Doisy recently demonstrated that the chemical structure of estrin is of hydrocarbon derivation similar to the carcinogenic hydrocarbons isolated by Cook. Clinically it has been repeatedly observed that in the highly malignant rapidly growing mammary carcinomas in younger women roentgen ray castration brings about varying degrees of growth inhibition in the primary tumor and even in the metastatic foci.

Practically all previously recorded work on mammary stimulation by ovarian extracts and hormones has been concerned with the physiological response. In this paper are presented the mammary gland changes produced in castrated rabbits by long periods of artificial stimulation with corpus luteum and estrin hormones.

## MATERIALS AND METHODS

Rabbits of various breeds were used, some immature, mainly adult virgin females. Control specimens of mammary gland were excised in each animal before castration was done or treatment begun. Castration was done by

wide excision about the ovaries including a portion of the oviducts. To determine whether any regeneration of ovarian tissue had occurred each animal was autopsied at the end of the course. This occurred only in one instance and the results from this rabbit were not used. In the 2 animals whose uteri were removed no difference was observed in the mammary response to theelin. Under local anesthesia control breasts were removed at intervals. Ovariectomies were done under nembutol or ether anesthesia.

Several sources of estrogenic substance were used. Some was obtained by the use of pregnancy urine which was heated to 60 degrees C. to inactivate the gonadotropic pituitary factor, filtered and standardized in rat units per cubic centimeter by the Allen Doisy method. The content was found to vary from 4 to 8 rat units per cubic centimeter. This was used undiluted. Estrin was generally supplied in the form of theelin and progesterin B.<sup>2</sup> The corpus luteum extract was tested for physiological activity by the progestational effect produced. All hormonal injections were given intravenously.

The mammary glands were fixed in Bouin's fluid, stained in hemalum, decolorized in acid alcohol and used as whole mounts in balsam, sections being first removed for microscopic examination.

## EXPERIMENTAL

*Stimulation by estrin and corpus luteum extract.* Three ovariectomized does (Bq, B1, B25) were given 50 rat units of theelin and 1 cubic centimeter of corpus luteum extract daily for periods varying from 20 to 45 days. As a result of this stimulation a ductal overgrowth with acinar hyperplasia branching out from the end ducts was caused. In one of the animals a thin milky secretion was present when the glands were sectioned. The gross mounts of a normal gland are illustrated in

<sup>1</sup> Es. l. k. sed. ne. m. f. es. h. t. n. c. g. d. Th. l. g. C. p. l. d. by P. k. D. & Co. d. p. g. r. o. s. B. by th. Sch. l. g. C. p. l. d. by P. k. D. & Co. d. p. g. r. o. s. B. by th. F. m. t. h. P. t. h. l. o. I. L. b. o. t. r. y. Co. wall Hospital



Fig. 1 Gross mount of mammary gland of rabbit in resting stage, showing only skeletal outline of ductal system  $\times 3.75$



Fig. 2 Gross mount of mammary gland after 21 days' stimulation with estrin and corpus luteum. Extensive growth of ductal system with feathery offshoots due to alveolar hyperplasia  $\times 2$

Figure 1 and that from an ovariectomized treated rabbit in Figure 2. Microscopically, there are well developed gland lobules and enlarged ducts lined by actively growing epithelium after 21 days of stimulation. The ducts are distended by desquamative product and an early secretion of milk. In Figures 3 and 4 are illustrated microscopical appearances of a normal and a stimulated breast respectively.

In one of these animals the course described was followed by injections of anterior pituitary extract for 6 days. A gland removed 2 days later was filled with milk, and comparison with a pregnancy control gland showed

almost the full lobular development of late pregnancy.

#### ATTEMPTED STIMULATION WITH CORPUS LUTEUM

Three rabbits, 1 immature and 2 adult females (B2, B12, B14) received daily doses of 1 cubic centimeter of corpus luteum extract for periods of 10, 54, and 81 days. Careful gross and microscopic examinations of specimens that had been removed at intervals and when treatment had been completed failed to show that any significant changes had taken place.



Fig. 3 Microscopic section from gland in resting stage. Ductal system only seen  $\times 27.5$

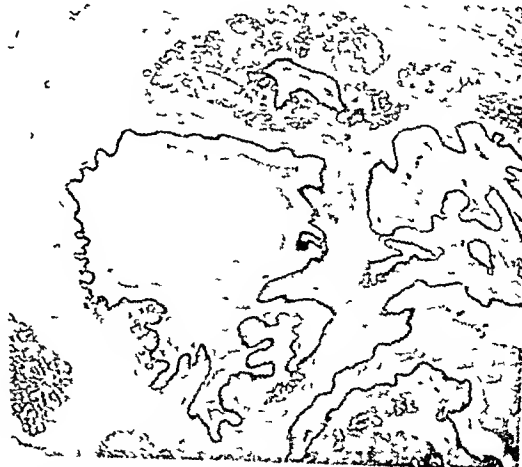


Fig. 4 Section from gland in Figure 2. Alveolar hyperplasia, ductal system dilated with early secretion and desquamation  $\times 27.5$



Fig 5 Fte ed tlo go thr li gfr m 60  
day t m l t n th str i X 75

#### CONTINUOUS STIMULATION WITH ESTRIN

Seven ovariectomized female rabbits 5 adult and 2 immature (Bx By B7 B21 B24 B26 B21c) received almost daily doses of estrin in some form and in varying quantities for periods varying from 30 to 187 days. Two of these 1 adult and 1 immature were treated for 187 days with three lapses of 5 to 8 days. The remainder were given courses varying from 30 to 130 days. The dosage varied from 25 to 200 rat units per day. The most active response seemed to be obtained from 50 rat units per day. Increasing the dosage past this point did not seem appreciably to enhance the gross or microscopic changes. One animal for example received 7300 rat units in 187 days and another 9150 rat units in 110 days but sections from both animals after 80 to 90 days showed even less response in the rabbit receiving the greater dosage.

One animal seemed refractory and failed to show any mammary change but the 6 other animals exhibited changes which were remarkably uniform at any given time in their different courses. Practically the only variation was in degree of proliferative response rather than any distinct deviation from the roughly uniform plan of growth and regression. The changes observed can therefore be presented generally for this series.

After about 30 days of estrin injections the gland is enlarged to 3 to 4 times normal size (Fig 5). The ductal system has ramified extensively with some widening particularly toward the main ducts. The pattern is that of the branches of a naked tree for there is no acinar growth. Microscopically there is little evidence of any increase in the acinar



Fig 6 Sect f mammary gla d fte 3 m ths of  
tum l t n w th estr i n Atyp c l p th lial hyperplasia  
w th tr d ctal pr l f t i o n d d e s c m t h a l l  
i a s n f a d j c e n t t m a c l u l a r c h a n g e s X 65

elements and most fields show only the ductal overgrowth. The lining cells of the ducts tend to be somewhat larger, present occasional flat papillary projections and are actively growing. At the end of 80 to 90 days except for a slight lobular proliferation there is little gross change in the glands removed. By this time however there have occurred striking histological changes. The ducts are now definitely increased in caliber but most arresting are the epithelial changes (Fig 6). The epithelium is piled up in layers, often projecting into the lumina of the ducts as papillary processes. In areas some smaller ducts are almost plugged with such cells. The epithelial cells are larger than in the resting state, oval or high columnar in shape. The cytoplasm is fairly clear and uniform, faintly acidophilic. The nuclei generally are fairly large, moderate in staining affinity and granular. Every section however revealed certain numbers of hyperchromatic nuclei, cells of bizarre shape and some showed mitotic figures. In certain sections the outer layers of this ductal epithelium showed a tendency to infiltrate the adjacent stroma.

With maintained or even increasing daily doses of estrin after this peak in ductal overgrowth had been obtained regression of the mammary glands occurred. Such regression usually commenced between the eighth and

one hundredth day of estrin administration, and continued until the size of the gland was similar to the resting breast. Gross mounts of the glands which had been stimulated as long as 187 days presented the same appearance as those of resting glands.

The section of breast removed at the end of the 6 month period shows that as much regression has taken place in cellular activity as in ductal growth. The lining epithelium is only two or three layers deep, the basal layer well defined, the cells smaller, regular with neutrophilic cytoplasm, and small evenly staining nuclei. Often the cells are compressed and small, with irregular cell outline. The ducts are only slightly wider than in the normal gland (Fig 7).

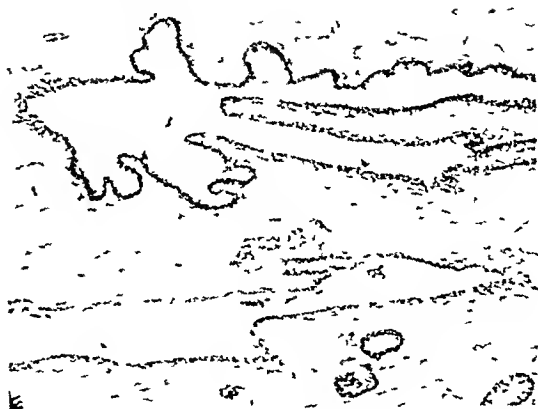


Fig 7 Section from gland after 6 months of estrin treatment. Loss of atypical epithelial changes first obtained, return of ducts to practically normal caliber.

#### INTERMITTENT STIMULATION WITH ESTRIN

Two mature virgin ovariectomized rabbits (B1, B5) were given staggered courses of injections. One animal received regular cycles of 5 days of stimulation alternating with 5 days of rest for 136 days, giving 50 rat units, 70 rat units, and 100 rat units doses in the first, second, and third months, respectively. This was followed by two longer periods (9 and 11 days) of stimulation with 100 rat units per day. A total of 6700 rat units of estrin was thus given over a total period of 173 days. A mammary gland removed midway through the course presented a moderate degree of ductal growth, with more obvious histological changes. Most noticeable of these were intraductal papillary epithelial processes and attempts at stromal invasion by groups of epithelial cells which were growing from the outer layers.

The second animal received irregular periods of estrin injection, varying from 3 to 14 days, with rest intervals of 2 to 10 days. A total of 3,000 rat units was given in 100 days. Ductal overgrowth again resulted, with distinct histological variations of some interest, comparable to those described. Many ducts are filled with hyperplastic epithelium, in others the duct wall is broken in outline due to piling up of cells and breaking of the basal layer. There is some variation in nuclear size, hyperchromatism and a few with mitotic figures were seen.

#### EVALUATION OF STUDY

That mammary growth resulted in intact and castrated animals treated with ovarian extracts was established in various species by Vintemberger, Allen, Hartmen, Dupré and Allen, Hartmen, Champy and Keller, Laquer et al. Working with various ovarian and placental extracts, and with no qualitative distinction between alveolar and ductal growth in some instances, these researches did not establish specific effects for specific hormones. Growth and arborization of the ductal system resulting from estrogenic substance were noted by Haterius.

The belief that the corpus luteum was a stimulator of mammary growth received support from Parkes in 1929. He prolonged the luteal phase in pseudo-pregnancy to the full time of true pregnancy by repeated injections of anterior pituitary extract. As a result of pituitary stimulation the ovaries became packed with corpora lutea. The concomitant mammary growth which simulated that of late pregnancy, he attributed to the ovarian changes.

Since 1930 Turner and his associates have made a series of notable contributions on mammary development. They have repeatedly demonstrated that estrin in castrated animals produced a ductal without alveolar growth, except in the guinea pig. When the stimulation was prolonged to 90 days, gross regression was noted. Although corpus luteum

extract failed to produce any proliferation of alveoli or ducts when used alone changes comparable to those of pseudo pregnancy were obtained by combining estrin and corpus luteum extract.

There is ample reason to question the role of the corpus luteum hormone as a direct stimulator of mammary growth. Although the potency of the luteal extracts used may be uncertain for mammary stimulation other experimental data tend to invalidate the place of progesterin in this field. Extensive alveolar growth in the glands of castrated rabbits was obtained by Turner and Gardner by the injection of anterior pituitary extract alone. In 9 days of such stimulation the lobules were greatly enlarged and the acini distended with milk. But little actual ductal growth was apparent. In this phase of alveolar growth for which the corpus luteum is supposed to be responsible. Considering again Larkins' success in producing complete mammary growth by repeated pituitary injections in intact animals it seems questionable whether the stimulus was of luteal origin as he thought or whether the anterior pituitary may contain hormones essential to the growth of the breast as well as the known lactogenic factor. It seems improbable that the gonadotropic factor could act directly on the breast in castrate while those with completely luteinized ovaries should have lacked sufficient estrin for full development of the mammary gland.

The results described in this paper substantiate the conclusion of Turner. Estrogenic stimulation has uniformly produced almost exclusively a ductal overgrowth which has usually reached a maximum in gross appearance at 30 to 60 days. Histologically there has been rapid proliferation of the ducts and moderate epithelial hyperplasia in the early stages of stimulation (30 to 60 days) with no acinar growth. Corpus luteum extract physiologically active as judged by uterine sensitization in standards has produced no mammary changes over long periods. The two hormones in combination readily produced an alveolar and luteal overgrowth with early secretory activity typical of the mammary gland in pseudo-pregnancy.

Actually the pituitary influence has not been eliminated in the recorded experiments on breast stimulation and until attempts are made to produce mammary growth with ovarian hormones in hypophysectomized animals it must be conceded that the anterior pituitary is as likely a source of stimulation for alveolar growth in the breast as the corpus luteum. It is also possible that the ovarian hormones one or both act on the breast only through the anterior pituitary. It seems unlikely that estrin breaks the soil for progesterin action in mammary development for this would infer a reversal of the growth phases seen in pregnancy where alveolar growth comes first and ductal development in the latter stages.

Our interest in breast stimulation arose primarily in the conclusions of Lewis and Cheschick that cystic disease of the breast resulted from overstimulation with estrin (ductal pathology) while excess luteal influence produced adenosis of the breast (acinar pathology). Their conclusions were mainly drawn from two sources. The results of Turner's experimental stimulation with estrin producing ductal growth and their observations on the histology of the human breast as seen in biopsies at various periods in pregnancy. During the first half of pregnancy they describe an acinar proliferation at which time it is claimed the level of corpus luteum hormone in the blood is high. In the latter months of pregnancy when estrin reaches its maximum concentration in blood and urine Lewis and Cheschick noted growth and dilatation of the ductal system with maturation of the cells.

Apart from the pitfalls inherent in correlating physiological data with pathological states these assumptions seem unwarranted. It has been amply shown that the present extracts of corpus luteum although otherwise physiologically active cannot alone produce alveolar growth in the castrated or intact animal. Furthermore the ductal dilatation which is a part of the overgrowth resulting from pure estrin stimulation is not prominent. Ductal dilatation becomes greatest when desquamation and early secretion occur and is thus more probably due to mechanical



effect rather than any specific influence of estrin on ductal caliber

The long and intensive stimulation with estrin here reported has failed to carry ductal growth and widening beyond a certain stage which at no time approached the appearance of cystic disease of the breast. Past this stage there has occurred regression in the ductal system with restoration to practically normal caliber. Alveolar growth, secretion and lactation, however, have been produced by anterior pituitary injections alone (Parkes, Turner, and Gardner). Of great interest was the possibility that estrin, because of its chemical structure and relation to the carcinogenic hydrocarbons, might experimentally provoke atypical epithelial hyperplasia. After continuous and cyclic courses of estrin administration, prolonged in some instances to 6 months or over, gross ductal overgrowth reached a peak in 30 to 60 days, and after 90 to 100 days regressed to a state almost identical with the resting stage. Histologically, varying degrees of epithelial hyperplasia appeared with many atypical features—intra-ductal epithelial projections, shallow infiltration of the surrounding stroma, hyperchromatic nuclei, mitoses, alteration in size and shape and other changes in cellular characteristics. On continued stimulation these potential neoplastic tendencies disappeared and the ductal epithelium returned to a normal appearance. The cellular activity thus paralleled the gross ductal overgrowth and regression. No actual neoplasm was produced.

Lacassagne has reported increasing the mammary cancer rate in both high and low tumor rate strains, and also having produced mammary cancer in male mice, by injections of "folliculine." Other investigators have been uniformly unsuccessful. Loeb calls attention to the fact that while carcinogenic hydrocarbons may act on a great variety of tissues, the estrogenic hormones are limited in their action to the tissues in which they ordinarily stimulate growth during the sexual cycle. The essential difference may be quantitative, and the cancerous transformation the result of proliferative processes acting over a long period of time. The transient imitations of ductal neoplasms obtained in this study sup-

port such a belief and further suggest that the mammary gland may exhibit periodic refractory states toward estrogenic hormones on which it ordinarily depends for stimulation. This would most reasonably occur after intensive stimulation. The next logical approach is to produce maximal mammary growth at successive periods, allowing complete regressions in the intervals.

Equally important is the substrate upon which the hormones act, and the possibility that the unaltered ovarian hormone may always be potentially carcinogenic if acting upon an altered mammary substrate. The incidence of mammary carcinoma is high in nulliparous women, in whom the breast has failed to achieve its normal purpose of lactation. Other established provocation may come from infections, benign, neoplastic or cystic changes. It is possible that preliminary, artificially produced changes in the character of the incipient mammary tissue might induce changes in normal cell equilibrium which would render it more highly sensitive to the growth stimulus provided by the estrogenic hormones.

#### CONCLUSIONS

1. The continuous administration of the (ovarian) hormone estrin in castrated rabbits produced, at first, a generalized overgrowth and ramification of the ductal system in the mammary gland with practically no acinar growth.
2. Carried further (100 days), little gross change occurs, but atypical histological variations appear in the ductal epithelium which often verge on the border line of neoplastic changes.
3. When such stimulation is prolonged for 6 months or more, both the gross ductal growth and microscopic epithelial hyperplasia regress to a nearly resting state. Ductal widening is not prominent under pure estrin stimulation.
4. In rabbits the response of the ductal system of the breast and its epithelium to continuous estrin stimulation is confined to certain limits, past which a refractory state is set up.
5. Estrin and corpus luteum extract in combination produce both ductal and acinar

overgrowth early secretion occurs and the ducts become distended

6 Dilatation of the ducts is probably mechanical from distention by secretion and not a specific effect of estrin

7 Estrin and progestin on the basis of present evidence do not produce specific pathological lesions cystic disease and adenosis

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THE EFFECTS OF ADMINISTRATION OF THORIUM DIOXIDE<sup>1</sup>

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THORIUM dioxide is now used extensively as a diagnostic aid in cerebral or peripheral arteriography and hepatorenography. Its use has been stimulated by observations indicating that it produces no immediate deleterious effect in animals nor definite symptoms in man, but like many other radioactive substances, it has not been in use long enough to permit more than speculation concerning its prolonged effect in tissues and organs. Two cases are briefly recorded which indicate that thorium dioxide is irritative and may ultimately produce a definite proliferative reaction in connective tissue.

There is no question about the radioactive property of this substance. Its average period of life has been estimated at about twenty-five thousand million years, so that when it is injected into living tissue, there is no doubt about its survival. It is further estimated that thorium and its disintegration products give off from 4,390 to 26,340 alpha particles per gram per second, depending on which products of disintegration are active at the moment. From 50 to 75 cubic centimeters of a 25 per cent solution of the dioxide (thorotrast) is frequently injected intravenously in the adult.

It is theoretically possible therefore that this substance may produce a tissue response in either of two ways: (1) mechanically, (2) radioactively. The mechanical effect, as a foreign body, would be non-specific and would probably occur in a few weeks or months. Present observations indicate that this is slight and often completely absent in reticulo-endothelial tissue. The radioactive effect would be indefinitely progressive.

A complete review of the investigations on thorium is not indicated here, but the following observations suffice to point out the conflicting opinions concerning the tissue response to this metallic irritant. Wen and Jung have demonstrated the distribution of thorium in the human body immediately following intravenous injection, and LePERT

has shown that over two-thirds of it is stored in the liver and spleen. No excretion occurred although animals were observed for several months. Harris reports the reaction of thorium dioxide on the lymphadenoid tissue of rats and dogs 2 months after injection. "There occurs a distinct stimulating reaction upon the connective tissue or stromal unit of the gland with loss of the lymphoid structure. Of unusual interest is the perivascular connective tissue proliferation which continues to increase concentrically about the blood vessels. Phagocytic cells containing thorium may be seen. A more advanced picture presents complete loss of parenchyma with connective tissue replacement in which the lymph spaces are clearly shown and at times appear dilated. Occasionally masses of phagocytic cells containing thorium show a surrounding encapsulation of connective tissue." Naegeli and Lauche report a case in which there was generalized necrosis of the lymph glands 3 years after thorium injection. Lambin has reported atrophy of the bone marrow with aplastic anemia following large doses, similar to the atrophy noted by Martland in cases of poisoning by radium salts used in the manufacture of luminous watch dials. Martland has more recently reviewed the whole subject of radioactive substances in contact with living tissues and stresses a grave note of warning against their use in even minute quantities. Gottlieb (3), on the other hand, considers that there is no injurious effect to the erythropoietic mechanism from the injection of small doses of thorium. Irwin, Dickson, and MacDonald also consider ordinary doses of thorotrast quite innocuous. Irwin reports neither exudative nor proliferative reaction 4 months after the intravenous injection of rabbits with 5 cubic centimeters per kilogram of the 25 per cent colloidal suspension. These variable findings prompt further observations.

CASE 1. Male, age 34 years. This patient received an intravenous injection of thorium dioxide (thorotrast) in right and left antecubital veins in order to

<sup>1</sup>From the University Clinic, Royal Victoria Hospital, Professor J. C. Meakins, director, and The Pathological Institute, McGill University, Montreal, Professor Horst Oertel, director.



Fig. Roe to right m h g b d se  
sh d w r d ced by the m s of th r um n the t ssu

outline a tumor in the liver. In attempting to get into the vein considerable thorium escaped into the surrounding tissue. The anterior surface of the right elbow soon became red and swollen. These signs of inflammation subsided in about 24 hours leaving a few small firm lumps which the patient could feel under his skin. These remained unchanged for a month and then a gradual progressive enlargement was noted. At the same time similar smaller lumps appeared in the left antecubital fossa. Four months later the masses in both arms were associated with considerable pain and interference with function. On examination the right antecubital fossa contained a series of firm nodules ranging from the size of a walnut to a pea apparently in the subcutaneous tissue and attached to the flexor muscles. In the left antecubital fossa were four similar smaller pea-sized nodules. All were dissected out and a Thiersch graft was done on right to restore skin defect. Recovery uneventful.

**Pathologic description.** The tissue removed from the right antecubital fossa after formalin fixation consists of a pale grey firm noncapsulated irregular rounded mass about 8 centimeters in diameter. To it is firmly attached small fragments of muscle and fascia on one side and an elliptical piece of

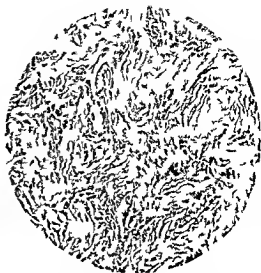


Fig. Hyaline fibrous tissue after injection of thorotrast

stretched skin about 10 centimeters long on the other side. It is difficult to cut and its surface is uniformly firm and pale grey. The tissue removed from the left antecubital fossa consists of two similar firm pale grey flat masses each about 3 centimeters in diameter. To these is also attached a few fragments of muscle and fascia.

**Histologic examination.** Sections of all the tumors show a similar picture. There is a large amount of pale brownish refractive material lying partly free but mostly within large angular shaped cells evidently of macrophage type. These have apparently phagocytosed the foreign material. There is a diffuse hyaline fibrous tissue which envelops blood vessels and medullated nerves (Fig. 2). Where the material lies in muscle the fibrosis is associated with atrophy of striated fibers. There are no foreign body giant cells and there is no evidence of neoplasia. The reaction appears to be a relatively mature form of hyaline fibrosis.

**Interpretation.** Hyaline fibrosis surrounding exogenous material (5 months after thorotrast injection).

**CASE 2.** Male age 65 years. This patient suffered from an operable cancer of the right bronchus. Five months before he died with a diffuse carcinomatous pleurisy given an intravenous injection of 50 cubic centimeters of the thorotrast. At autopsy no gross evidence of thorium was found in the reticuloendothelial tissues.

**Histologic examination.** Liver. There are very diffusely granular pale brown refractile masses scattered between the columns of hepatic cells. This material fills many capillary endothelial and Kupfer cells. Surrounding central veins the masses become much larger and extracellular, lying between

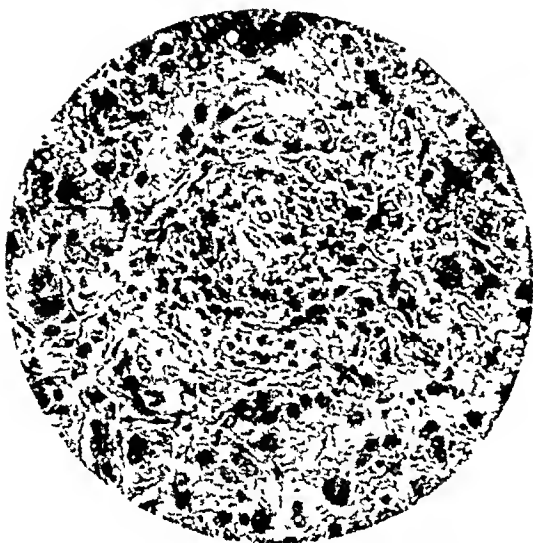


Fig 3 A portal district in Case 2 showing proliferative reaction surrounding thorotrast which was injected 5 months previously  $\times 265$

compressed parenchyma cells. In portal spaces the material is surrounded by fibroblasts and scattered mononuclear leucocytes (Fig 3). In many places the fibroblasts appear relatively mature and collagen fibrils are abundant. This reaction is absent in portal districts which contain less of the material. There is no evidence of a cholangitis.

**Anatomical summary** Productive hepatitis associated with exogenous material (Thorotrast injected 5 months previously).

**Spleen and regional lymph glands** The metallic substance lies mostly in large phagocytic cells in the center of lymph follicles but some is also outside the cells. These resemble reticular cells. There is no definite fibroblastic proliferation.

#### EXPERIMENTS AND RESULTS

It has been stated by some workers (Dickson, Gottlieb, 2) that no radioactivity could be demonstrated in colloidal thorium dioxide (thorotrast). Two simple experiments conclusively prove this radioactivity.

1 The apparatus consisted of a well constructed  $\alpha$ -ray electroscope calibrated so that it required 172 hours for the gold leaf to pass over 8 divisions of an arbitrary scale. The contents of 1 ampule of thorotrast<sup>1</sup> was evaporated to dryness and placed in the ionizing chamber. It was then found that the charge on the electroscope leaked away in 11

<sup>1</sup>Hysden Chemical Corporation, New York.

Fig 4 Photographic shadow of lead arrow developed in the presence of thorium rays in a microscopic section of liver from Case 2.

minutes. This is proof of the marked radioactivity of the thorotrast preparation.

2 To demonstrate the radioactivity of thorium in tissue, a frozen section of the liver of the second case was used. A section 30 microns thick and 1 centimeter square was mounted dry on a glass slide and put 1 centimeter above the emulsion surface of a panchromatic "M" photographic plate. A small lead arrow was placed on its sensitive surface between it and the liver section. Special care was taken not to expose the plate to light during this manipulation. At the end of 5 days a photographic shadow of the metal arrow had developed (Fig 4). Liver sections which did not contain thorium were used as negative controls.

**Conclusion** Rays from the thorium contained in this very thin section of liver have been photographed.

While it is impossible to distinguish sharply between those tissue changes which are due to thorium as a mechanical irritant and those which are due to the alpha, beta, and gamma particles, it is reasonable to assume that both mechanical and physical properties are concerned in the tissue responses. It is noteworthy that the proliferative reaction in these 2 cases is greatest in situations where connective tissue is normally most abundant. Thus the fibrous tissue increase is much greater in perportal districts containing the metallic substance than about the central veins, although the substance is about equally distributed in both these regions. On the other hand, lack of tissue reactions in the spleen and lymph glands is a noteworthy and surprising fact. There seems to be, therefore, a considerable variation in the reaction, or tolerance, of different kinds of tissues and



## THE VASCULARITY OF BENIGN AND MALIGNANT LESIONS OF THE STOMACH

A COMPARATIVE STUDY WITH CLINICAL CORRELATIONS

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THIS work was undertaken with the idea of throwing light on a question which has interested gastro-enterologists and pathologists for many years. The question is: Are benign and carcinomatous ulcers of the stomach dependent for their origin and chronicity on the presence of degenerative and obstruction producing changes in the blood vessels of the stomach and particularly in those in the floor of the ulcer? Up to the present all students whose work I know, who have attempted to demonstrate these changes, have used a purely histological technique. I have attempted to measure cross sections of the blood vessels supplying the regions of ulceration, to compare these measurements with those of cross sections of blood vessels supplying apparently normal parts of the same stomach and in this way to estimate and compare the blood supplies of the two regions. If the so called vascular theory of causation of ulcer is correct, one would expect to find a poorer blood supply in the region of the ulcer

## LITERATURE

In 1853 Virchow definitely enunciated the vascular theory of genesis of peptic ulcer. Hauser, in 1883, added to the literature a monumental work on the relationship of vascular lesions to chronic gastric ulcer. He concluded that whoever wished to produce a gastric ulcer must begin by producing disease in the gastric vessels.

Since Hauser's time many investigators have studied this subject, among whom may be mentioned Hoff, Monpeurt, and Ophuels. Durante, in 1916, in discussing the trophic element in the origin of gastric ulcer concluded that trophic disturbances in themselves are not sufficient to cause ulceration, unless accompanied by spastic contraction of the vessels or vascular disturbances resulting in hemorrhage. Vascular disturbances have

been studied, notably, by Kurosawa, by Schuetz, and by Held and Goldbloom.

Of the many attempts that have been made to produce gastric ulcer by ligation or obliteration of gastric vessels, those of Cohnheim and of Omata are of particular importance in relation to this study. Much experimental work has been done also in an effort to learn more about the nature of the hemorrhagic erosions so often seen in the gastric mucosa (5, 6). The possible relationship between vascular disturbances and cancer also has been considered (20). Konjetzny has repeatedly championed the view that gastritis is preliminary to the development not only of ulcer but also of cancer. Borchardt made a similar study of fifty resected stomachs and stressed the presence, in association with primary cancer, of sharply demarcated gastritis. Schomburg suspended excised stomachs so that the capillaries were visible through a microscope. In cases of ulcer the vessels were dilated, filled with blood, and branching, whereas in cancer the capillaries were small, thread-like, and sometimes absent.

Reading of the literature concerning the vascular theory of genesis of ulcer, both that which has been cited here and other material, indicates to me that vascular changes are of some importance in the formation of certain types of chronic gastric ulcer. I am not satisfied with the evidence in favor of the view that there is a difference between the changes in the blood vessels seen in cases of benign and in cases of malignant gastric ulcer.

## METHOD EMPLOYED IN THIS STUDY

*Histological studies.* Surgically removed gastric specimens were used as the basis for the study. Fifty-seven resected lesions were divided into four groups according to their histological characteristics. There were 18 benign ulcers, 20 ulcers in which there was evidence of

secondary cytoplasia (MacCarthy 12 13 14) 14 ulcers which contained areas of beginning carcinoma and 5 definitely carcinomatous ulcers

From the formalized specimens blocks were taken from the borders of the ulcers and for control observations similar blocks were taken from the apparently normal mucosa of the same stomach as far distant from the ulcer as possible

All of the sections were made in the same manner. The block was frozen and the cut made parallel to the mucosal surface so as to obtain a cross section of the tubules and blood vessels. Each section was 10 microns thick and as far as possible was taken 0.5 millimeter from the surface of the flattened mucosa. In most of the specimens this depth corresponded to half the mucosal thickness. Various stains were tried but the results with hematoxylin and eosin were sufficiently satisfactory that this stain was used exclusively in preparation of tissue for the actual study. The tissues were mounted in balsam of Peru.

The sections were first inspected under low power and using India ink on the cover slip a representative area showing a uniform picture of the tubules was marked off for study. From these areas camera lucida drawings of the lumens of cross sectioned blood vessels were made using a Spencer camera lucida and a Leitz monocular microscope with the oil immersion lens. The magnifications were computed by means of the Bausch and Lomb millimeter scale.

The areas of the lumens of the vessels were measured with a planimeter and the figures were reduced so that the total area of the lumens could be expressed as a percentage of the area of stomach studied. A description and photograph of the planimeter used can be found in Allen's article on the measurement of the veins in the suprarenal glands.

Identification of the walls of the vessels was at times so difficult that certain standards were applied in the hope that they would obviate mistakes attributable to the presence of erythrocytes surrounded by connective tissue fibrils.

Distinction between vessels carrying arterial or venous blood was not attempted all

vessels seen were drawn. Only vessels with distinct walls were measured. If the area of the lumen changed with the focus the largest distinct area was drawn.

*Studies made by injection.* In 5 cases the vessels of the resected portion of stomach were injected immediately after its removal. The right and left gastric and the right and left gastro epiploic arterial stumps were isolated and the lumens flushed with an 8 per cent solution of sodium nitrite. They were then injected with a material opaque to roentgen rays. Various injecting media were tried. Several specimens were injected with a compound of India ink and gelatin and an attempt was made to clear the tissues with alcohol acetone and oil of wintergreen. The results were disappointing presumably because of the thickness of the tissue. Injection of metallic mercury made it possible to obtain satisfactory roentgenograms. A 25 per cent solution of sodium bismuth tartrate also was tried in the belief that its low surface tension as compared with that of mercury would not hinder its entrance into the smaller vessels. The results were no better and since mercury gave a clearer picture this was finally employed exclusively. Blocks of tissue were taken as in the other experiments and the results of the measurements of the blood vessels were first studied separately and later averaged in with those of the other ulcers.

#### CALCULATIONS

To obtain the areas of the lumens of the blood vessels the area as taken from the planimeter reading was multiplied by the planimeter constant and this in turn was divided by the appropriate constant of magnification of the microscope. Similarly to obtain the area of the entire section in which the vessel were measured the reading of the planimeter was multiplied by a constant and divided by the constant of magnification of the microscope. The ratio between these two areas that is the vascular area and the area of the section expressed as a percentage gave a measure of the fraction of a cross section of the tissue that was occupied by blood vessel and was taken as an index of the blood supply. For the normal tissue this is symbolized by



$D_n$ , that is, the density of the vessels in the normal tissue, for the pathologic tissue, it is symbolized by  $D_i$ , that is, the density of the vessels in the area of ulceration. The difference between  $D_i$  and  $D_n$  gives an index of the abnormality in blood supply of the pathologic tissue. This difference will be referred to henceforth as  $D$ , or the index of vascular density. The details of the calculations appear in the appendix, at the end of this article.

The means, standard deviations, and zones of probable error were calculated in each of the four groups. A summary of the data is given in Table I.

Unfortunately, there are several sources of error in these procedures. It has been shown that sections from different parts of the same ulcer may vary in cellular characteristics, that is, a section from one side of the crater may contain cells that are normal, while a section from the opposite side may contain cells that give evidence of secondary cytoplasmia. The outlines of the vessels doubtless are changed by the fixing agent used to preserve the tissues. Variations in the depth at which the section was taken might well influence the number of blood vessels per cross section and possibly also the size of the vessels. Errors might arise through mistaking other structures for vessels. The drawing of the lumens of the blood vessels, with the help of the camera lucida, and the measurements with the planimeter, leave other opportunities for error.

Some idea of the magnitude of the combined errors, together with the natural variations of the data, has been obtained by computing the standard deviations of the figures in the several groups.

#### RESULTS OF HISTOLOGICAL STUDIES AND OF STUDIES MADE BY INJECTION

The figures given in Table I are based on measurements of more than 8,000 arterioles and capillaries, that is, the results now to be given concern the histological studies.

In the group of 18 benign ulcers the mean difference between the vascular density in the ulcerated part and in the non-ulcerated parts of the stomach was  $+1.30 \pm 0.59$  per cent.

TABLE I—INDICES OF VASCULAR DENSITY

	Mean percentage of tissue occupied by blood vessels		Mean difference $D_i - D_n$	Mean ratio $D_i : D_n$
	Ulcer $D_i$	Normal $D_n$		
Benign ulcer	1.5	1.95	-1.30	1.31
Secondary cytoplasmia	1.15	1.4	-1.1	2.51
Early carcinoma	1.1	0.61	-1.1	5.51
Definite carcinoma	2.10	0.7	-1.15	3.01

The index of vascular density in the first case in the series of benign ulcers was much higher than that in other cases. It was so much like that found commonly only in cases of malignant ulcer that I wondered if this lesion might not have been wrongly diagnosed. Accordingly, more sections were studied, but no evidence was found of premalignant or of malignant changes. Moreover, the patient from whom the ulcer was taken was alive and well when last heard from 1 year after operation. Both of these facts supported the diagnosis of a benign ulcer. Excluding this case from the series the mean difference in vascular density was  $+0.53 \pm 0.61$  per cent, a difference which from statistical considerations is even less likely to be significant than the other was. Obviously, then, this study does not offer any support to the theory that ulcer arises in an area poorly supplied with blood. In these cases if there was any difference, it was in favor of the area of ulceration, that is, this area had a little more blood supply than the rest of the stomach had.

In the 20 cases of secondary cytoplasmia the mean difference was  $+2.11 \pm 0.28$  per cent. In the 14 cases of early carcinoma there was a mean difference of  $+4.21$  and  $\pm 0.90$  per cent. In the 5 cases of definite carcinoma there was a mean difference of  $+1.45 \pm 0.55$  per cent. This suggests that the blood supply of a carcinomatous ulcer is greater than that of a benign ulcer or than that of normal gastric mucosa.

These differences seem small until one expresses one percentage as a fraction of the other (column farthest to right, Table I). Then it will be noted that with benign ulcer the vascularity of the tissue near the lesion was half again as great as in the rest of the stomach. In the case of secondary cytoplasmia

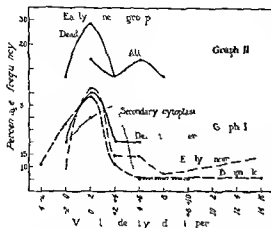


Fig. 1. Graph showing percentage distribution curves of the index of ulcer density in the groups studied. Group 1. Distribution curves of the index of ulcer density in the group of early carcinoma, digestive peptic ulcer and the group of dead.

it was 2.5 times as great in early carcinoma, 5.5 times as great in advanced carcinoma, 3.0 times as great.

Figure 1 graph shows percentage distribution curves summarizing the data for the various types of tissue studied. It will be seen that with the exception of data for secondary cytoplasm all the curves have the same mode. The differences in the means are attributable to the presence of some unusually low percentages in the group of benign ulcer and to many high readings in the group of early carcinoma.



Fig. 2. Case. Resected gastric specimen including the ulcer, showing all minute details.

The observations on the 5 injected specimens will be considered separately, in what immediately follows.

**CASE 1.** This specimen (Figs. 2 and 3) represented 15 centimeters of stomach which gave evidence of several benign chronic inflammatory ulcers on and near the lesser curvature, the largest one measured 1.5 by 2 centimeters and the smallest 3 by 2 millimeters. The attached nodes were inflammatory. The injection preparation revealed the ulcer very well with the area to the left relatively avascular. There was a rich pyloric blood supply and several arterioles could be traced directly into the crater of the ulcer. The index of vascular density was 4.0 per cent.

**CASE 2.** The preparation was made with a 25 per cent solution of sodium bismuth tartrate. The lesion was a perforating chronic gastric ulcer 1.0 centimeter in diameter with a crater reaching into the muscular mucosa on the lesser curvature. There was no visible gastritis except for a small area around the edge of the ulcer, but microscopically there was a definite inflammatory reaction of grade 2. Here again the shadows of the vessels could be traced into the base of the ulcer. The index of vascular density was 0.64 per cent.

**CASE 3.** This specimen contained a simple perforating type of gastric ulcer measuring 1.5 centimeters by 1.5 centimeters by 12 millimeters on the lesser curvature 5 centimeters from the pylorus. The injected preparation contained a clearly defined area where the vessels did not fill and which corresponded to the crater. The presence of the avascular area together with an index of 0.60 per cent suggested to me that this lesion might fall in the group of definite carcinoma, but histologically the

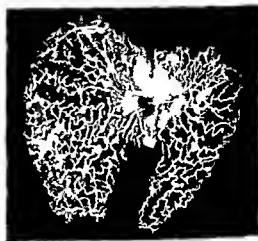


Fig. 3. Roentgen gram of injected specimen. Index of vascular density 4.0 per cent.

was no evidence of malignancy. The patient was alive and well 6 months after operation.

**CASE 4.** This specimen (Figs. 4 and 5) contained a perforated, ulcerated adenocarcinoma (grade 2) measuring 2.5 by 2 by 1.5 centimeters, with a second ulceration adjoining it, toward the cardia on the lesser curvature, measuring 8 by 8 by 4 millimeters. In the nodes were inflammatory changes. Three submucous hemorrhages were visible grossly and their presence was indicated also by escape of the medium used in injecting the preparation. During the operation the omentum had been torn from the greater curvature and this may explain the poor injection of the pylorus. The index of vascular density here was +4.70 per cent.

**CASE 5.** This lesion was a large, ulcerated adenocarcinoma (grade 3) of the posterior wall, measuring 4 by 2.5 by 2 centimeters, with involvement of lymph nodes. In the roentgenogram there was a definite area around the crater where the vessels did not become injected. The index of vascular density was +2.25 per cent.

#### THE INDICES OF VASCULAR DENSITY IN RELATION TO MORTALITY

The results just given appear to show that one factor altering the course of a malignant lesion may be a change in vascularity. If it is correct to assume that changes in vascularity influence the development of both benign and malignant ulcers, then there might also be a similar correlation between the vascularity of the lesion and the future course of a patient from whom that ulcer had been removed.

For this part of the study, if the cellular characteristics of various sections from any

one ulcer differed, then that ulcer was grouped on the basis of the tissue that was least differentiated. A colloquial way of expressing the foregoing would be to say that an ulcer was grouped on the basis of the most malignant tissue found within it. The groups bore the same names as those borne by groups mentioned earlier in the paper: benign ulcer, secondary cytoplasia, early carcinoma, and definite carcinoma. In Table II is summarized the clinical analysis of these groups.

The mortality figures for the groups were correlated with the vascular density indices. In the group of benign ulcer 82.5 per cent of the patients were alive approximately 2½ years after operation. In the group of secondary cytoplasia, 85.8 per cent of the patients were alive 2½ years after operation, and none of the remaining patients died of cancer. In the group of early cancer the reverse situation was present, only 31.2 per cent of these patients were alive and 62.4 per cent were either dead or had recurrence at the end of 1½ years after operation. It is important to note that the average index of vascular density of the patients who died of cancer was  $+2.76 \pm 1.27$  per cent, whereas the index for the living patients was  $+5.59 \pm 1.20$  per cent (Fig. 1, graph 2). In other words, it is suggestive that with two exceptions the patients who lived had highly vascular carcinomatous lesions, whereas those who died had lesions of much less vascularity.

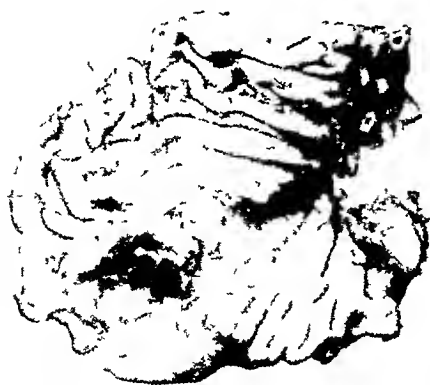


Fig. 4. This gross specimen of resected gastric tissue from Case 4 included a perforated, ulcerated adenocarcinoma.

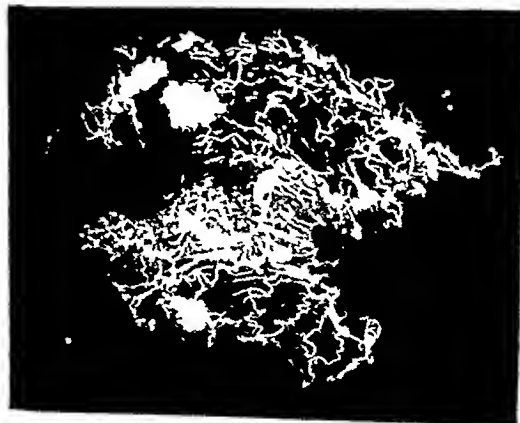


Fig. 5. Roentgenogram, after injection, of the specimen represented in Figure 4. Index of vascular density +4.70 per cent.

TABLE II—CLINICAL ANALYSIS OF CASES

I	Age	Sex	A. I. m. p. t. m. b. p. s. ar.	Clinical	Pathologic
He x le 8 cases	5	M—d	—	Lo. rs. t. 7 A. ag. 11 7 5.8 mm	5—Al 3 m h t 5.3 rs 6 3 —P 1 1 h —1 ed 3 rs f pe m h l d t —1 d 1 rs f pe m h l d t
Sec. ary 3 t. la 3 ce	4	M—	8 5	Lo 8 1 11 A. 1 5.3 mm	—Al m h t 5.3 rs 6 3 —P pe 1 h —1 ed 3 rs er pe p m ary ca m es —V f 11 w
Ex. ly m cen	8 5	M—	5	Lo. rs. t. 7 1 11 A. 1 5.3 mm	—Al m h t 5.3 rs 6 3 —P 1 1 h —1 ed 3 rs er pe p m ary ca m es —V f 11 w
D f 7 cases	38	M—	7	P 13 b o 5 A. 8 t 36 m	3—Al f ar b d nc —1 d f ca h d 3 rs f pe 10 —V f low p

Furthermore the means of the indices of vascular density show that the vascularity of the lesions from the living patients was more than twice as great as that of the lesions from the patients who had died from cancer. This correlation is in accord with the assumption made. In the group of definite cancer wherein the vascularity was still further decreased only 1 patient or 16.6 per cent was alive and well one year after operation.

#### COMMENT

Granting that the separation of ulcerating gastric lesions into the groups named was correctly made by the pathologists it was thought probable that the index of vascular density as has been defined in the foregoing would decrease from the benign ulcers to the definite carcinomas. The results were exactly the opposite.

The gradation in vascularity from normal tissues up through benign ulcers, ulcers with secondary cytoplasia to beginning carcinoma and then down to fully developed carcinoma suggests that the figures do mean something. They obviously do not support the belief that ulcers begin in a region of lowered vascularity. So far as I can see they suggest that with the increased metabolic rate of tissues around an ulcer there is on the average a slightly increased demand for blood. This demand would tend to be increased still more if the

cells were to become cancerous and as Warburg contended to have a higher metabolic rate. Later as the carcinoma grew the associated fibrous tissue and rapidly multiplying malignant cells might strangle some of the blood vessels and perhaps lower the vascularity of the growth. Whether the cellular changes antedate the variations in blood supply or vice versa no one can say.

Obviously the index of vascular density could not be used diagnostically in the case of an individual ulcer. It is only the mean of the measurements taken from several lesions that can be significant.

Those of my studies which were carried out on resected and injected stomachs do not support some of the contentions of other authors. There is a marked anastomosis between the vessels of both curvature so that blocking of any one vessel would not necessarily produce an infarct. The small capillaries of the submucosa are end arteries in a strict sense but the actual area of mucosa supplied by these is so small that it is difficult to imagine a chronic lesion resulting from blockage of one or even of several of these vessels.

#### SUMMARY AND CONCLUSIONS

1. Fifty-seven gastric ulcers were divided on the basis of histological characteristics into four groups: benign ulcer, 18 ulcers giving

evidence of secondary cytoplasm, 20 ulcers containing areas of early carcinoma, 12, and definite carcinomatous ulcers, 5.

2. The areas of cross sections of the lumens or blood vessels bordering the ulcer and the areas of cross sections of lumens or blood vessels of the normal mucosa, from the same specimen, were calculated by means of camera lucida drawings and the planimeter. More than 8000 individual measurements were made. The difference between the two figures obtained from each specimen, and expressed in percentage, is called the vascular density index.

3. The average index for benign ulcers was  $+1.30 \pm 0.59$  per cent, a figure which is statistically not significant. This probably means that there is no actual difference in vascularity between the mucosa bordering the ulcer and the normal mucosa of the affected stomach.

4. The average index for the ulcers which give evidence of secondary cytoplasm was  $+2.11 \pm 0.28$  per cent. The probability is that the vascularity in these areas is increased.

5. The average index for the ulcers which gave evidence of early carcinoma was  $+1.21 \pm 0.60$  per cent. This indicates that the blood supply to the early carcinoma is still further increased.

6. The average index for the definite carcinomatous ulcers was  $+1.15 \pm 0.55$  per cent. This result suggests that the blood supply to the frankly cancerous area is much decreased as compared with that of the early cancerous areas.

7. Obviously, these studies do not offer support to the theory that ulcers begin in a region of decreased vascularity.

8. Studies were made by injection of stomachs resected for ulcer, and of ulcerating lesions. Carcinomatous ulcers became injected much more poorly than benign ulcers.

9. The postoperative course of the patients in each group was correlated with the vascular density indices. The index for the 7 patients in the group of early carcinoma, who died of cancer, was  $+2.76 \pm 1.27$  per cent. The index for those living was  $+5.59 \pm 1.20$  per cent. The indication is that patients suffering from carcinomatous lesions with a low blood

supply have less chance of surgical cure than if the lesion has had an adequate blood supply.

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## APPENDIX

The following symbols have been employed for the sake of brevity

- total blood vessel area measurement in section of m ulcer
- b— total tissue area measurement in section of m ulcer
- c— total blood vessel area measurement in section of m normal stomach
- d— total tissue area measurement in section of m normal stomach
- e— planimeter standard for blood vessel area measurement in section of m ulcer
- e— planimeter standard for tissue area measurement in section of m ulcer
- f— planimeter standard for blood vessel area measurement in section of m normal stomach
- f— planimeter standard for tissue measurement in section of m normal stomach
- m— microscope magnification of the blood vessels (800)
- m— microscope magnification of the tissue areas ( )
- x— total actual blood vessel area in section of m ulcer
- y— total actual tissue area in section of m ulcer
- x— total actual blood vessel area in section of m normal stomach
- y— total actual tissue area in section of m normal stomach
- D— total actual blood vessel area per sq cm of section of m ulcer
- D— total actual blood vessel area per sq cm of section of m ulcer
- D— index of area density

Since the following object =  $\frac{\text{area of the image}}{\text{magnification}}$  the value

obtained may be substituted

$$(\quad) = \frac{\left( \frac{\text{sum of blood vessel measurements times}}{\text{planimeter standard}} \right)}{800^2}$$

$$x = \frac{\quad}{m}$$

$$(2) \quad y = \frac{bc}{m} \quad \left( \frac{\text{m of section measurements times}}{\text{planimeter standard}} \right)$$

$$(3) \quad x = \frac{c}{m} \quad \text{or} \quad \left( \frac{\text{sum of blood vessel measurements times}}{\text{planimeter standard}} \right)$$

$$(4) \quad y = \frac{d}{m} \quad \left( \frac{\text{sum of section measurements times}}{\text{planimeter standard}} \right)$$

$$(5) \quad D = D_u - D$$

$$(6) \quad D - D = D^2$$

Substitute (1) (2) (3) and (4) (5) and (6) in the

$$\frac{\frac{c}{m}}{\frac{bc}{m}} - \frac{\frac{ce}{m}}{\frac{d}{m}} = D$$

Simplify

$$\left( \frac{m}{m} \right) \left[ \frac{1}{bc} - \frac{c}{de} \right] = D$$

Therefore, the

$$\left( \frac{\text{blood vessel area in sq cm the microscope}}{\text{area of the section of the ulcer}} \right) - \left( \frac{\text{blood vessel area in sq cm the microscope}}{\text{area of the section of the ulcer}} \right)$$

$$\text{minus} \left( \frac{\text{blood vessel area in sq cm the microscope}}{\text{area of the section of the ulcer}} \right) - \left( \frac{\text{blood vessel area in sq cm the microscope}}{\text{area of the section of the ulcer}} \right)$$

the difference in the blood vessel area per sq cm

The figures  $\left( \frac{m}{m} \right)$  is a magnification constant (eq 100 97)

Let per m  
normal per m

BILIARY DUODENAL INTUBATION<sup>1</sup>

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SULLIVAN, in 1909, after a series of animal experiments, suggested the possibility of a choledochoduodenal intubation with a straight tube for traumatic division or stricture of the extrahepatic bile ducts. Brewer, in 1910, accepting Sullivan's suggestion, reported a case in which he performed a hepaticoduodenal anastomosis over a tube which entered the duodenal wall directly. The tube passed, and the patient did well for a while but subsequently returned with the signs of obstruction. McArthur, in 1923, reported 7 cases of plastic operations on the common bile duct in which he used choledochoduodenal intubation, having operated upon the first case in 1908. Since then this procedure seems to have become definitely entrenched in the surgery of the extrahepatic ducts, and its sphere has spread beyond the domain of reconstruction for which it was originally intended.

The prejudice against foreign bodies in surgical operations was largely mitigated by the excellent results obtained by the Murphy button, and while it may not enjoy such great popularity at present, it still has many definite indications. It is essentially true that any foreign body employed as an aid to anastomosis, may become a source of trouble. It may be retained giving rise either to irritative symptoms or to an intestinal obstruction, but these disadvantages are more than counterbalanced by the many advantages accruing from its use. The hazards of biliary duodenal intubation have been probably exaggerated. It has been stated that the indefinite retention of the indwelling foreign body may lead either to a persistent biliary fistula or to cholangitis. The tube may either become plugged and encrusted, causing complete biliary obstruction, or by its protrusion into the duodenum, act as an open pathway for a duodenal reflux, causing an ascending infection with cholangitis. Actually in clinical practice, while these untoward complications may develop, they are extremely rare. However, it is fully appre-

ciated that cases terminating favorably are more apt to be reported than those attended by serious and fatal postoperative complications.

Time and experience have added many modifications which have perfected the technique of biliary duodenal intubation. The past decade has witnessed a great improvement in the manufacture of rubber, for the tubing even though it may be retained for months, seems to resist the destructive and disintegrating influences of the bile salts. Moreover there seems to be little tendency for the bile salts to be precipitated and occlude the patency of the lumen, provided the tube has been of sufficient diameter. Naturally the greatest care should be exercised in selecting the best and highest grade rubber, radiopaque, if possible. A variety should be chosen which though soft and pliable, is resistant enough to maintain its lumen against external pressure in spite of ample fenestration. Many opportunities have been afforded to examine tubes which apparently have remained in a bile duct for almost a year. The majority of these have been found in an almost perfect stage of preservation containing very little deposit of accumulated bile salts. While it is undesirable that these choledochoduodenal tubes be retained indefinitely, it is important that they remain fixed in position until their specific objectives have been fulfilled. Some surgeons (4) control the choledochal portion of the tube from slipping into the duodenum by anchoring one end of a silk ligature to the tube, fastening the other to the skin. This is hardly necessary. Premature delivery does not appear to be an imminent danger since the use of the small caliber tube has been discarded. A tube which will snugly fit the choledochus is the most desirable for intubation. The narrowed and spastic area of the papilla will usually lead to mechanical dilatation so that a choledochal tube of rather large dimensions may be easily introduced 8 to 10 centimeters down

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Fig 1. Case A. Spad od n l po tion f mm n ble du t d by adl 1  
d od m A P of psed du d nal alle mpt t ly ccl d g mm n ble d cl B Orign al  
ch led cho tomy C Chol do hod den f nt bat

into the duodenum. Even though the sphincter of Oddi will grasp the tube tightly at first the rubber will be dislodged eventually by the downward flow of the intestinal contents aided and abetted by the intermittent activity of duodenal peristalsis. A tube may pass in 4 weeks (Case 4) or may be retained for over a year (Case 3). Judd reported a tube in place for 4 years before it caused cholangitis. These tubes rarely cause intestinal obstruction in their transit along the gastrointestinal tract.

Biliary duodenal intubation is indicated in many primary conditions and in some of the postoperative complications involving the extrahepatic ducts. It affords a mechanical channel through which bile may be delivered immediately into the intestinal canal and practically eliminates a biliary fistula. Cases of obstructive jaundice clinically do much better after operation if the bile is restored to the human economy as quickly as possible for many patients seem detrimentally affected by a complete biliary fistula. The loss of bile seems to interfere seriously with digestion and absorption and in many instances causes such rapid physical deterioration that complete disintegration appears likely unless bile is refed by duodenal gavage.

The majority of incisions into the common bile duct even if the choledochus is immediately sutured are followed invariably by biliary drainage lasting for weeks or even months. Aside from the presence of unre moved calculi one of the main causes for a biliary fistula is a tonic spasm of the sphincter of Oddi. Some surgeons have advocated dilatation of the spastic sphincter by slowly stretching it with graduated sounds at the

time of operation. The choledochotomy is then firmly sutured. Even this procedure has one distinct disadvantage. It may occasion a traumatic obstructive edema of the papillary region resulting in an increased intraductal pressure with dehiscence of the choledochal suture line.

Choledochoduodenal intubation via the papilla removes this possibility and stretches the sphincter so thoroughly that the effect of the dilatation will remain long after the tube has passed. Some surgeons notably Duval and Walzel state that biliary duodenal intubation is an innocuous procedure and should be employed more frequently. They believe it may be used to advantage even in simple cases of common duct obstruction due to tone in which it may be desirable to eliminate external drainage.

This procedure is certainly indicated in those cases of fistula which have drained bile for a prolonged period and in which secondary exploration is indicated and those reoperated upon cause of secondary obstruction in which it is desirable to eliminate the debilitating effects physically and economically of another biliary fistula.

CASE 1. Illustrates the partial application of the principle. This patient following the removal of choledochal calculus drained bile for 35 days. The wound finally healed and he remained perfectly well for 6 weeks when he experienced an episode of fever and jaundice. He was readmitted to the hospital. The diagnosis of common duct obstruction. The second exploration disclosed normal appearing but dilated duodenum with the supraduodenal portion of which was not only covered by adherent duodenum but the bowel wall had actually prolapsed into the pre-existing choledochostomy wound completely occluding the lumen of the common bile duct. No calculus was



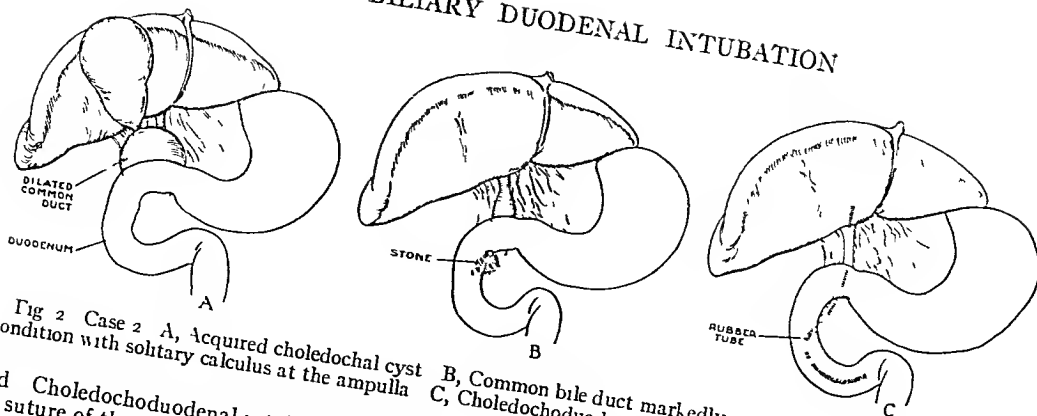


Fig 2 Case 2 A, Acquired choledochal cyst condition with solitary calculus at the ampulla B, Common bile duct markedly contracted from previous cystic condition with solitary calculus at the ampulla C, Choledochoduodenal intubation

found Choledochoduodenal intubation with immediate suture of the duct was done because it was felt that this procedure would protect the patient against a recurrence of this complication, and eliminate a biliary fistula After operation, aside from an abdominal wall wound infection, the course was fairly smooth There was never any jaundice or bile drainage, and bile appeared promptly in the stools The patient states he has never passed the tube and, unfortunately, the x-ray is of no value to determine its presence, for radiopaque rubber was not used

Another definite indication for biliary duodenal intubation is in the treatment of choledochal cysts, either congenital, idiopathic or acquired McWhorter so completely reviewed this subject recently that no further comments of a general nature are necessary Case 2 is presented as an acquired cystic dilatation of the common bile duct It is recognized that this type is extremely rare and that many surgeons might question the propriety of reporting this case as such However, it cannot be classified as a simple dilatation of the common bile duct due to obstruction at the papilla

CASE 2 This patient was an elderly negress with a history of cholelithiasis Operation revealed the presence of a cholecystitis with a small calculus, and a large choledochal cyst Digital exploration and instrumental examination of the common bile duct which had been converted into a large cylindrical reservoir failed to reveal the presence of stone, and the papilla was patent to a probe The cyst was drained by choledochostomy It was felt that with the relief of an elevated intraductal pressure, the wall of the common bile duct might contract sufficiently so as to eliminate subsequent plastic procedures After operation, however, the loss of bile in this patient was a serious complication She became morose, apathetic, and non-co operative, developed a severe anemia and lost excessive amounts of weight If it had not been for the sup-

portive treatment given by the use of a transfusion and continuous intravenous glucose, there is grave doubt whether she would have survived this critical period The patient was discharged in a month with a fistula which closed 8 weeks later She subsequently returned with a subhepatic accumulation, which, when incised, drained pus and bile Following discharge she was not seen again for 4 months, at which time she stated that she had been draining bile continuously during this period Lipiodol studies of the fistulous tract demonstrated a single large stone impacted in the papilla and incidentally revealed the fact that the common bile duct had markedly shrunk from its original size

Exploration under spinal anesthesia disclosed a solitary soft calculus which chemical analysis revealed to be bilirubin The stone evidently developed in the choledochus sometime after the first operation as the result of bile stasis and infection It seemed imperative, in view of past experiences with this extremely debilitated patient, that, if possible, an operation should be selected which would immediately restore a free and non-obstructed flow of bile to the intestine Choledochoduodenal intubation fulfilled all these requirements There was some biliary discharge for a few days but bile was present in large amounts in the stool 4 days after operation She has had no recurring symptoms and has gained 55 pounds in the past year The tube which was retained for 12 months, was finally passed without difficulty Examination showed the rubber to be in a perfect state of preservation and free from precipitated bile salts

While the indications for biliary duodenal intubation have increased, its main use still is the restoration of accidentally divided or strictured bile ducts It is in the secondary operative procedures involving the latter group that the indwelling tube is often indispensable For, aside from acting as a canal for the immediate delivery of bile, its mechanical pressure eliminates the obstructive features of a traumatic inflammatory edema



Fig 3 Case 3 A A suture for common bile duct B A d C Cholecholeodochodu d n l  
tub tion ith om tum c en g e p s d int bated t be

which usually develops at the site of anastomosis. In certain cases the indwelling tube provides a scaffold along which a portion of a new duct may be reconstructed.

The plastic procedures of choice in biliary canal reconstruction are preferably those in which it is possible to unite mucous membrane to mucous membrane. The danger of secondary stricture from the contracture of fibrous connective tissue is markedly diminished by this simple expedient. But unfortunately it is not always possible either to perform an end-to-end suture of the ducts or institute a choledoch or hepatico-duodenostomy. Even the results in these procedures are obviously more successful if an indwelling tube is used. But biliary duodenal intubation becomes

absolutely essential in those instances in which the stricture is either so located or the defect in the duct is so extensive that an end-to-end anastomosis of the duct is impossible. In these particular cases the intubated rubber tube acts as a bridge to span the gap between the distal and proximal portions of the duct. The area of the exposed rubber is carefully covered by the adjacent tissues of the gastro-hepatic omentum or the omentum itself. Occasionally because of extensive scarring and dense adhesions only the proximal portion of the duct may be located. This may be intubated while the distal part of the tube may be introduced directly into an opening made in the duodenum. The area of the anastomosis so made may then be covered with the aid of neighboring fat and connective tissues. While Sullivan has shown in animals that biliary duodenal intubation in instances of division or loss of substance of biliary ducts is followed by a regeneration of ductal epithelium growing along and eventually encompassing the rubber tube, there is very little proof if any that the same happens in the human. Autopsies obtained in patients dying of some intercurrent disease years after a reconstruction of the extrahepatic ducts with loss of substance are exceedingly few. The postmortem appended to Case 3 is therefore of unusual and exceptional interest.

This woman died of hypertensive cardiovascular disease about 2 years after a intubation for stricture of the choledochus in which end-to-end suture was not possible. Examination of the specimen showed that the reconstructed duct was patent throughout and possessed a lumen equal in diameter to the normal duct above and below even though the bile canal was imbedded in a mass of dense fibrous



Fig 4 Ca 3 D ing f post t in pecun  
g ca f eco tru t d num b l d ct

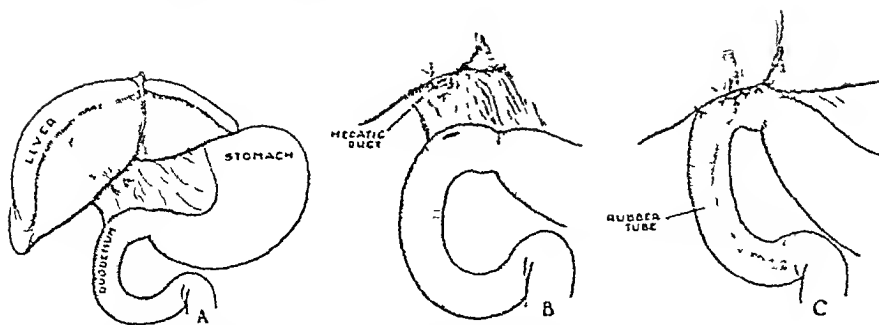


Fig 5 Case 4. A, Scar tissue occluding hepatic duct in region of porta hepatis B, Hepatic ducts at the porta hepatis after excision of scar tissue C, Hepatoduodenal intubation.

connective tissue There was no histological evidence in this case that a lining epithelium had regenerated from either the proximal or distal segments of the duct

This emphasizes that fibrous connective tissue under certain conditions may provide a temporary satisfactory channel if a sufficient diameter is originally planned so that the secondary contractures of scar tissue from within and without will not obliterate the lumen The new canal mechanically served its purpose for 2 years and drainage was sufficiently free so as to protect against active cholangitis Whether another stricture would have eventually developed if the patient would have survived longer, is problematical Recurring strictures in this type of case are certainly not unusual Even a so called "mucous membrane to mucous membrane anastomosis" over a tube is no guarantee against their occurrence Secondary strictures with cholangitis are the bugbear of reconstructive surgery of the extrahepatic ducts

CASE 4, a hepatic duodenal intubation for stricture of the hepatic duct at the porta hepatis illustrates the complications of recurring stricture This patient, a young married nurse, developed a hepatic duct stricture at the porta hepatis following a cholecystectomy and suffered severely from the systemic effects of an almost complete obstructive jaundice It was important to relieve the jaundice and at the same time, if possible, restore the bile to the intestine by internal drainage Hepatoduodenal intubation immediately relieved the jaundice which soon resulted in a visible improvement of the patient The tube was recovered within 4 weeks after operation If this patient had not been carefully followed, the case might have been reported as a brilliant result following hepatoduodenostomy Unfortunately, however, within 3 months after

operation, episodes of chills, fever, and jaundice occurred, although during the attacks, bile was always obtained by duodenal drainage A barium meal persistently failed to outline the biliary radicles These findings apparently predicated a beginning stricture at the site of the anastomosis causing stasis, ascending infection, and cholangitis It was suggested that a pyloric exclusion with gastroenterostomy might divert the stream of gastric contents, materially diminishing a possible source of the ascending infection This would not eliminate the element of stricture with its biliary stasis The case is rather typical of the follow-up results in reported cases of hepatoduodenostomy Invariably, evidences of cholangitis develop

It is indeed problematical whether the institution of any other plastic procedure in strictures near the porta hepatis would protect against the dangers of cholangitis It might have been a better procedure to have first established a biliary fistula with the thought of eventually transplanting a firm sinus tract into the stomach or duodenum While the earlier reports of this procedure were enthusiastic, subsequent follow-up examinations have robbed this operation too of some of its former glamour Most patients with strictures at the porta hepatis appear destined eventually to succumb to the fatal effects of hepatic infection no matter which plastic reconstructive measure has been employed

#### CONCLUSIONS

Biliary duodenal intubation has become a recognized and valuable surgical procedure in selected cases of certain primary diseases and as a secondary procedure in postoperative complications involving the extrahepatic bile ducts It is indicated when the restoration

of bile by internal drainage is imperative and the elimination of a biliary fistula is essential. It is exceedingly useful in reconstructive procedures of the bile ducts in which either an end to end anastomosis or a hepaticoduodenostomy or choledochoduodenostomy is feasible. Its use is problematical however in those plastic procedures in which there is a loss of substance of the bile ducts and in which the indwelling tube is used as a temporary canal and scaffold along which a new tube of ductal epithelium may regenerate. It is still questionable whether bile duct epithelium will reform to any great extent.

It is more than likely that the replacement will be made by connective tissue which will eventually contract resulting in all probability in secondary strictures with bile stasis ascending infection and cholangitis.

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## WHEN TO REMOVE THE DRAINAGE TUBE IN COMMON BILE DUCT DRAINAGE

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**S**URGICAL drainage of the common bile duct is generally advocated for the following conditions: stones, cholangitis, pancreatitis, and cholangitis with chronic fibrosis of the duct. Drainage has been for the relief of biliary obstruction, the cure of infection, the discharge of sand, for irrigations, to determine the character of the excretion of bile, to permit duodenal feedings, and to insure physiological rest of the biliary system. The surgical literature is filled with "pros" and a few "cons" by eminent authorities on the advisability of external drainage of the common duct. The advisability of introducing a tube into the common duct will not be taken up at this time. It is rather the methods in use to determine that the goal of drainage has been reached that are to be considered. Expressions of opinion have not been accompanied by specific data that determine when the drainage has been carried on long enough to secure the desired end. There are opinions given and cases cited advocating the immediate suture of the common duct, 10 days' drainage, 6 weeks', 2 months', and for longer periods of time. In the recent literature the usual opinion given is that prolonged drainage is necessary to rid the common duct of infection. There are few more specific data found on the length of time drainage is necessary. Walters in 1928 advocated drainage with the Mayo-Robson tube in cases of common duct stone with jaundice for a period of 10 to 12 days. Lobinger in 1924 advised the use of a small tube introduced through the cystic duct and left in place for a period of 20 days. Deaver was the greatest exponent of prolonged drainage of the common duct for infectious conditions of the bile ducts and pancreas. Moynihan advises prolonged drainage with either the T tube or two tubes with one turned up into the hepatic duct for irrigation and another down into the duodenum for duodenal feedings and sphincter dilatation, embodying

the principle of McArthur in feeding and of continuous dilatation of Sir Henry Thompson in dilatation of urethrae.

The early method of Mayo-Robson in introducing and suturing a catheter into the duct insured drainage for 8 to 12 days through the tube and for longer periods of time through the sinus that developed about the tube. After the tube came away the closure of the sinus and cessation of the drainage depended upon the normal discharge of bile into the duodenum. For drainage of the duct following removal of stone in cases with mild cholangitis the method of Mayo-Robson gave very excellent results, and it is still the method of choice.

For prolonged drainage of the duct, the Kehr-Deaver T tube was developed and very generally accepted. In this tube the surgeon had a means of drainage that could be kept in place indefinitely. Leakage around the tube and inadvertent discharge of the tube were not controlling factors.

By quoting a few recent personal communications, the variety and differences in methods and time of drainage in use can be demonstrated. Dr. John F. Erdmann on August 9, 1935, writes:

In regard to the tube drainage in cases of calculus cholecystitis, I have allowed a tube to remain in from 5 to 13 days, feeling that when the catgut has absorbed so that the tube can be lifted out without any trouble a sufficient amount of drainage has been established. If the opening of the duct does not close spontaneously, we know that a sinus has developed from the duct up to the abdominal wall, this as a result of the period of time the tube was in the duct and abdominal cavity.

For years, fully 30 or 35, I have been in the habit, as you will recall during your work with me at the hospital, of suggesting to the patients who have biliary leakages to eat a cracker or a piece of bread and drink a glass of milk during the night, just about midnight or shortly after, and this would reduce the amount of discharge. This has always demonstrated to me that drainage was taking place through the papilla of Vater.

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If the liver system showed a condition of cholangitis I prefer to drain much longer and in those cases especially during the past few years I have used the T tube. I do not feel that the T tube is absolutely necessary as for years I have been getting better results by using an ordinary catheter taking great precaution to sew through the skin and the catheter to the abdominal wall and tying loosely

Dr E Starr Judd on August 13 1935 writes

It is my feeling that as a general rule drainage of the common bile duct is not maintained long enough to obtain the maximal degree of benefit thus procedure offers. In my work I practically never use anything but a T tube for this purpose. This also applies to cases in which stones are removed and in which the calculi are the primary consideration. In these the T tube is allowed to remain in situ at least a month. The tube is left in place a much longer time than this if there is evidence of infection a tendency toward the formation of fibrous tissue around the duct particularly an inclination to develop stricture etc. No harm comes from leaving the tube in place several months in these cases and I am sure that with this plan I have been able to accomplish a great deal for some of these patients

Dr Edwin Beer on August 12 1935 writes

In draining the common duct I believe one should take advantage of the drainage and study the liver output and determine whether bile sand or stones are being discharged from the liver especially in common duct stones. If such appear in the drain age I have usually irrigated with a small catheter so as to wash out the deep ducts as well as possible and have left the tube in the common duct until apparently all such fragments or sand have been discharged. Naturally an accurate determination of this is impossible so that after 3 or 4 days of clear bile and no result from the irrigation the tube is withdrawn from the duct and the bile is collected through the sinus tract.

In ordinary cases where there is no discharge of bile sand or stones from the tube in the common duct I usually leave the tube in about 8 to 10 days until the bile is clear and then withdraw the tube into the sinus tract allowing the duct to close and the incision and the duct to close.

Recently I have tried what Pribram suggested in a recent article in SURGERY GYNECOLOGY AND OBSTETRICS where he has suggested the duct with small quantities of ether in the hope of dissolving the small cholesterol containing stones. In one such case three or four fragments of a broken stone were discharged from the common duct after such treatment. The patient having had a recurrence of jaundice with sudden reopening of the common duct. He has remained jaundice free for 4 or 5 months apparently all the fragments were dissolved or washed out with ether plus saline irrigations.

Some years ago with protracted common duct tube drainage I believe a stone developed in the common duct which I attributed to the irritation of the protracted indwelling tube. The patient had a carcinoma of the head of the pancreas which may have been pancreaticitis so that a long drainage was carried out until the jaundice disappeared. For several months the patient remained free from symptoms and then the jaundice set in again. The patient was operated upon by another surgeon who failed to recognize the pancreatic pathology. A good sized choledochotomy and removed a stone of good size. This stone surely was not in the common duct at the time I operated about 6 months earlier. The patient died within a few months and autopsy showed typical pancreatic head carcinoma.

Dr W Wayne Babcock on August 10 1935 writes

It has been our custom to drain the common duct for 10 to 14 days or until the bile is transparent golden yellow before removing the tube in the cases in which there is no serious obstruction or infection. If however there is evidence of chronic cholecystitis or a structured condition then prolonged drainage has been used in certain cases and continued many months.

If the drainage of bile is prolonged we have the patient drink it disguised in grape juice or adenister it through a duodenal tube. We consider the retention of a tube through the sphincter of Oddi to be dangerous.

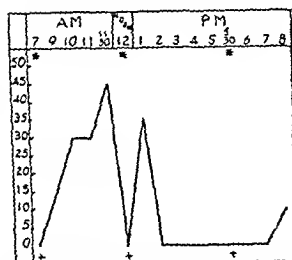
Dr H A Royster on August 12 1935 writes

It has never been my practice to leave a tube in the common duct more than 10 days. I do not believe the bile should be drained outside for a longer time than that. If a patient's interest is deprived of bile entirely beyond 10 days his nutrition in my experience begins to suffer. Moreover if a T tube is employed through which the bile may flow into the duodenum 10 days is also long enough for the stricture is likely to result in the common duct if the tube remains in a longer time. Late effects of stricture are not uncommon.

Dr Stuart McGuire on September 5 1935 writes

I think the longer a common duct is drained after the removal of a stone the better. I usually leave the drain in until it is accidentally displaced. In actual practice I think I drain cases from one to three weeks.

Whatever the indications for drainage may be there should be some way to determine when the conditions necessitating drainage have been met. The general condition of the patient with respect to pain temperature



\*Breakfast, dinner, supper + Empty bottle. Total, 165 cubic centimeters

Fig 1 Hourly drainage record

jaundice, and the general character of the bile discharge is relied upon in general to determine the type of drainage method to be used and the length of time of drainage

For the past 4 years at the Post Graduate Hospital observations have been made on the bile with a view to determining when the condition had been met for which drainage of the common duct was instituted. In addition there have appeared in the literature on this subject some methods of examining the bile discharge that bear directly on the subject

#### TESTING THE SPHINCTER OF ODDI

The most common need for external biliary drainage is for the relief of bile obstruction. The immediate release of biliary obstruction and its effect upon liver function make drainage by any method desirable until the cause, either mechanical, functional, or both, has been removed. Clamping the tube on about the eighth day has been widely employed to detect that bile would pass into the duodenum. If pain occurred the tube was freed to be clamped again in 2 or 3 days for another test. This test determines the possibility of opening the sphincter of Oddi with the full secretory pressure of the liver. In cases of spasm or inflammatory stricture too great to be overcome, there result obstruction, dilatation of the ducts, and, unless the clamp be removed, rupture of the suture line in the duct with discharge of bile around the tube. The presence of bile in the stools has also been used to determine the patency of the sphincter of Oddi. Pribram has advocated injection into duct through drainage tube of a radio opaque substance and then an x-ray film to determine passage of fluid through sphincter

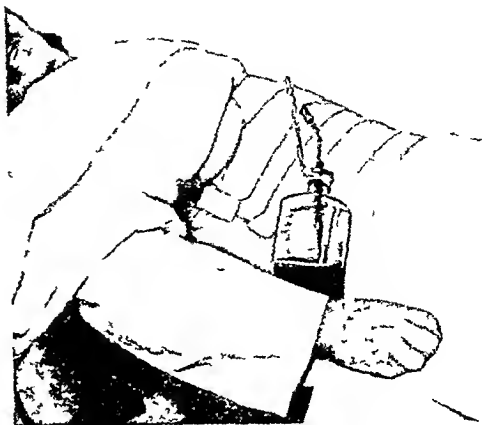


Fig 2 Bottle in correct position for gall-bladder drainage

Acting upon the thought in a suggestion made to patients by Dr John F Erdmann, that they eat something about midnight to decrease the drainage into the dressing during the morning hours, an hourly measure of the bile drainage during the day was recorded. Especial attention was directed to the amount of bile drained following meals. In this way the physiological response of the sphincter of Oddi can be determined by the amount of drainage into the bottle during periods just before and after meals. There will be an increase of drainage into the bottle following meals when the sphincter of Oddi does not respond and open after food is taken. In Figure 1 the amount of biliary drainage decreased following breakfast and luncheon, and after dinner there was no drainage from the tube. This method is applicable only when the end of the drainage tube is higher than the common duct, otherwise syphonage of bile might occur.

Figure 2 represents a method which has been devised by Dr John F Erdmann of attaching the collecting bottle for gall-bladder drainage to the patient.

In some instances in which a patient does not respond to this test after a period of time sufficient for an inflammatory stricture to have subsided the administration of belladonna results in the usual physiological response. This is indicative of spasm of the sphincter.

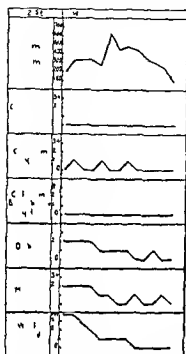


Fig 3. Pus in biliary drainage daily microscopic report

Another method that was tried and discarded because of the strain upon the suture line from vomiting was to test the flow of bile into the duodenum following magnesium sulphate and olive oil stimulation through the duodenal tube. In case of the response of the sphincter there was an increase in volume of dark bile flowing from the duodenal tube with a decrease in flow into the bottle from the common duct drainage tube. This method would be applicable in prolonged drainage after the wound had thoroughly healed. The response to food intake is thought to be more reliable even when the administration of beladonna is necessary.

In cases in which obstruction was the only factor the drainage tube could be removed safely as soon as there was a definite response after a meal. We do not feel that any case can be decided on this test alone as infection plays a part in all. Other and further tests are necessary before the tube can be withdrawn safely.

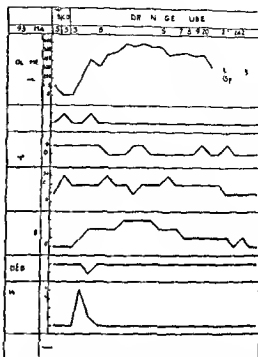


Fig 4. Biliary sediment in drainage bile daily microscopic report.

#### TESTING FOR SIGNS OF INFLAMMATION

Pus in the biliary discharge is an index of the inflammatory reaction within the duct (Fig 3). A daily microscopic examination of the drainage from the first specimen obtained at operation until the tube is removed will furnish valuable information. As a rule there is pus in the operative specimen of all cases but those of simple common duct stone. In the simple stone cases the operative specimen will show an occasional pus cell but no clumping of cells. On the second day after operation there will appear frank pus in the bile in large amounts. The presence of the tube may be responsible for this. In a few days (10 to 14) the pus disappears and only a few white cells will be found. In the severely infectious cholangitis cases pus will be present in the operative specimen and it may continue to be found for longer or shorter period of time. The infection of the glands in the wall of the common duct and the smaller bile capillaries may result in a purulent discharge in the bile



for many weeks or months. The tube should not be removed until the purulent discharge has ceased and there is to be found only an occasional white cell such as may be caused by the presence of the tube.

The colon bacillus is the most common organism associated with common duct stone and cholangitis. Daily cultures are also very likely to be contaminated by other organisms on the tube or from the dressings. This means of testing the length of time for drainage has been discarded.

#### SEDIMENTATION OF BILE

Crystals of calcium bilirubinate and bile sand in the biliary drainage have an especial significance. The drainage tube should not be removed so long as crystals appear in any quantity. Cholesterol crystals rarely appear in the bile after the first week during which the fragments of the stone are being washed out. The analysis of common duct bile during the postoperative period rarely shows cholesterol in any but very small amounts. In any case in which cholesterol is present in the bile in any appreciable amount together with crystals of cholesterol, usually in fragments of stone, that does not clear up within a few days, there is a strong suspicion that a stone was overlooked in the duct at the time of operation.

Calcium crystals in any quantity appearing in the bile after cholecystectomy have been noted in cases of associated pancreatitis and the appearance of large amounts of pancreatic ferments in the bile drainage. It may be shown by further experience that the drainage tube should be retained in cases of an associated pancreatitis so long as large numbers of calcium crystals appear.

The persistence of calcium bilirubinate crystals (Fig 4) takes place in patients who have a continuation of pus and a colon bacillus infection. In patients with this combination, the tube is retained after the pus disappears, the sphincter is proved to be operating normally and so long as there are calcium bilirubinate crystals present in any quantity. It is difficult to describe quantity in this respect. In our laboratory the sign of plus-minus is reached before removing the tube.

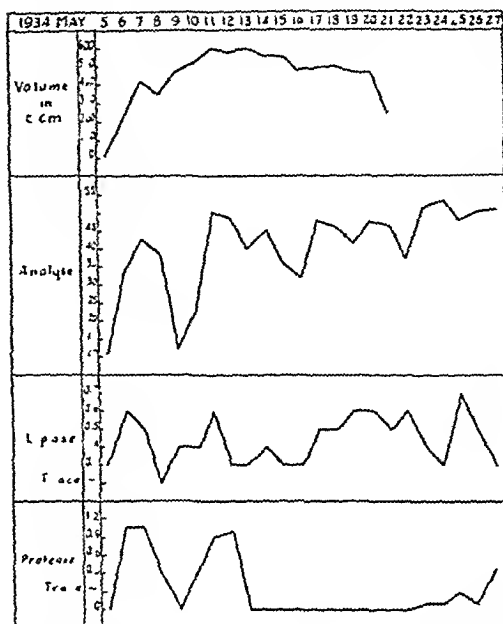


Fig 5 Pancreatic ferments in biliary drainage, daily determinations.

This insignia is used when in a non-centrifuged specimen there is occasionally found a small portion of calcium bilirubinate. No tube in these patients has been retained long enough to discharge a specimen in which, after searching through many specimens, some crystals could not be found. Following discharge from the hospital fragments of calcium bilirubinate crystals have continued to be found in plus-minus amounts in specimens obtained by duodenal tube drainage.

#### PANCREATIC FERMENTS

The presence in the biliary drainage of large amounts of pancreatic ferments, especially lipase and protease, does not permit the early removal of the tube. The excoriation of the abdominal wall about the wound is a painful complication. This can be prevented by retaining the tube until there is little likelihood that drainage from the sinus will be prolonged. The presence of pancreatic ferments in large amounts in the biliary drainage must occur in those patients in whom the pancreatic duct opens into the common bile duct above the sphincter. Their presence indicates an admixture of bile and pancreatic juice in

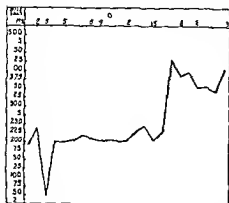


Fig. 6 Bile salt content by daily chemical analysis

the common duct. In such instances special precaution should be observed against removal of the tube before inflammatory or spasmodic changes of the sphincter have undergone resolution. Prevention of wound excoriation can be obtained in this way (Fig. 5).

#### TREATMENT OF PANCREATITIS BY BACTERIOPHAGE

In a recent series of patients with subacute pancreatitis the bacteriological department has been administering a specific bacteriophage against the colon organism. Retention of the tube in the common duct and drainage has been of value in the recovery of specimens for testing for bacteriophage and the presence of colon bacillus. This series of patients has proved of interest and a later report will follow.

#### CHEMICAL EXAMINATION OF THE BILIARY DRAINAGE TOTAL VOLUME ICTERUS INDEX AND CHOLESTEROL CONTENT OF THE BLOOD

A daily chemical analysis of the bile for bile salts, cholesterol and pancreatic ferments has been carried out on routine drainage cases. This phase of the observation has confirmed the previous findings of Greene, Walters and Frederickson. A drop in bile salt output following operation is an indication for intensive liver therapy by the intravenous administration of glucose, sodium chloride and fluid (see Fig. 6).

High cholesterol figures in the common duct bile that do not disappear quickly following operation are suggestive of retained stone.

The daily postoperative blood cholesterol has been found to vary greatly in patients without any apparent cause. It is not considered to be of assistance in determining the proper time for removal of the drainage tube.

Blood bile acid tests have been discontinued by the laboratory as they are considered unreliable and of no assistance in the treatment of these patients.

As to the icterus index of van den Bergh reactions are important but they do not assist in the removal of the tube. The changes indicated have been restored to normal limits before the local condition, as evidence by examination of the biliary drainage.

#### HEALING OF THE BILIARY SINUS

Drainage of the common duct that is controlled by examination of the biliary drainage should result in almost immediate cessation of bile drainage upon removal of the tube. A small spot of bile stained serum is all that should collect on the gauze pad after the tube is removed. In some instances belladonna is kept up following removal of the tube to insure solid union of drainage incision in common duct.

#### SUMMARY

1. The relief of obstruction by drainage can be determined to have been accomplished when the sphincter of Oddi responds to the food test. Clamping the tube to determine the state of the sphincter of Oddi is not a necessary procedure.
2. The presence of pus in the biliary drainage may be taken as the period of active inflammation within the duct.
3. Daily cultures of the biliary drainage are not reliable in determining the necessary drainage period.
4. Sedimentation of bile with crystalline formation, especially of calcium bilirubinate should cease before the tube is withdrawn.
5. Pancreatic ferments in the biliary drainage contra indicate removal of the tube before the sphincter of Oddi has been definitely restored to normal, as shown by the food test.

6 Daily bile salt determination of the biliary drainage, as has been previously determined, is a distinct aid in treating liver failure in patients with badly damaged hepatic system the result of obstruction and infection

7 Prolonged drainage of the common duct does not seem to be essential in most cases, to meet the requirements for which drainage was instituted Careful analysis of the biliary drainage and response of the sphincter of Oddi are essential in determining the time of drainage necessary

8 A careful analysis of the case during the postoperative period giving special attention to the function of the sphincter of Oddi, to the chemistry of the bile, microscopic study for crystalline sediment and pancreatic ferment determination is of great importance in the administration of specific postoperative medical therapy

9 Earlier removal of the common duct drainage tube may be possible when specific postoperative medical therapy is instituted and carried out

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## OVARIAN FUNCTION AND OCCURRENCE OF MENOPAUSAL SYMPTOMS FOLLOWING HYSTERECTOMY

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It is a general clinical experience that hysterectomy tends to hasten the onset of menopause. All investigators have come to this conclusion but they do not agree on the question of whether the retention of one or both healthy ovaries has a retarding and mitigating effect on the appearance and intensity of menopausal symptoms.

Graves believed that the so called menopausal symptoms are observed with virtually the same frequency after removal of the uterus with or without removal of the ovaries. He attributed the symptoms to a break in the utero ovarian functional harmony and regarded the retention of ovarian tissue after hysterectomy as of little physiological value and even productive of possible harm to the patient. Tolak held a similar opinion.

On the other side of the question are Scissors and Murphy, Stacy and Hawks who claimed after many hundreds of observations that hysterectomy usually hastens the onset of menopause but menopausal symptoms occur in more patients appear sooner and are more severe when all ovarian tissue is removed than when one or both ovaries are saved.

In cases of supravaginal hysterectomy where enough functioning endometrium had been preserved to retain signs of menstruation as in 36 per cent of the cases of Scissors and Murphy menopausal symptoms were much less likely to appear than in the remainder of hysterectomized patients.

Lecène and d'Allaines reported 130 cases of high fundal hysterectomy with ovarian conservation. In 128 of these patients menstruation persisted and of these only 10 per cent showed any premature symptoms of menopause.

These and similar clinical observations seem to indicate that the greater the amount of normal endometrium preserved in hysterectomy the less likely are menopausal symptoms to follow.

This assumption would also explain the difference of opinion among gynecologists relative to the value of preserving ovarian tissue in hysterectomy. The retention of a certain amount of endometrium appears to be of equal importance for the retardation of menopausal symptoms as the conservation of ovarian tissue. The more radically the uterus and especially the endometrium are removed in the respective techniques followed the more likely are menopausal symptoms to develop.

During the last few years numerous investigators have tried to establish the actual relationship between the activity of the endometrium and ovarian function using animal experimentation. In the guinea pig Loeb found that the removal of a considerable part of the uterus was followed by prolongation of life and function of the corpus luteum which prevented ovulation as long as it was functionally active. He concluded that the endometrium in the guinea pig produced an internal secretion which had an abbreviating effect on the life of the corpus luteum.

Scissors and Murphy made a thorough experimental study of the gross microscopic structure of rabbit ovaries removed several months after hysterectomy. They found that hysterectomy in the rabbit brings about degenerative changes in the ovaries. In a number of the hysterectomized rabbits in which endometrium had been autotransplanted they found less inhibitory and degenerative changes in the retained ovaries. They concluded that the endometrium elaborates a hormone which influences the ovary.

Zimmermann made similar experiments on rabbits with corresponding results. From their experiments on mice and rats Parfenoff and Winter came to like conclusions.

In the human ovary anatomical changes such as cystic degeneration and atrophy have frequently been found after hysterectomy but these changes are neither constant nor specific.

TABLE II

Case	Age at time of hormone assay	Age at operation	Diagnosis	Menses	Type of operation	Date of operation	Date hormone assay	Time between operation and first hormone assay	Result of hormone assay		Present Clinical Symptoms
									Estrin	Prolan A	
9	34	30	Fibroids	Menorrhagia	Supravaginal hysterectomy	6-29-31	3-2-35 3-9-35 3-16-35 3-23-35	3 yrs 3 mos	10 m u 20 m u 20 m u 80 m u	25 m u 50 m u	No hot flushes
10	38	31	Fibrosis uterus	Menorrhagia Dysmenorrhea	Supravaginal hysterectomy	5-31-34	2-1-35 2-19-35	3 yrs 8 mos	10 m u 10 m u	50 m u Negative	No hot flushes
11	35	29	Fibroids	Menorrhagia	Supravaginal hysterectomy	10-3-33	2-18-35 2-25-35 3-4-35 3-11-35	6 yrs 5 mos	20 m u 20 m u 80 m u 20 m u	25 m u Negative	No hot flushes Hyperthyroid
12	36	31	Fibroids	Normal	Supravaginal hysterectomy	5-10-30	2-26-35 3-5-35 3-12-35 3-19-35	4 yrs 9 mos	40 m u 20 m u 20 m u 30 m u	Mice died Mice died Mice died 50 died, 25 neg	No hot flushes Hypertension and head aches
13	30	27	Tubal pregnancy 1 mos Interstitial Ruptured	Normal until pregnancy	Supravaginal hysterectomy Left salpingectomy	7-23-31	11-26-34 12-6-34 12-12-34 12-30-34 5-25-35	3 yrs 4 mos	80 m u Neg 5 m u 5 m u 40 m u	Negative Negative 50 m u	No hot flushes
14	38	20	Fibroids Cyst right ovary	Menorrhagia	Supravaginal hysterectomy R salpingo-oophorectomy	10-15-24	11-20-34 11-27-34	10 yrs 1 mo	10 m u Neg	Negative Negative	Never hot flushes
15	37	30	Fibroids Cyst left ovary	Irregular Dysmenorrhea	Supravaginal hysterectomy and left salpingo-oophorectomy	12-29-28	1-2-35 1-8-35	7 yrs	5 m u 10 m u	75 m u 50 m u	Hot flushes started recently
16	22	22	Pregnancy term Dystocia	Normal until pregnancy	Supravaginal hysterectomy postcaesarean	4-23-34	11-2-34 11-9-34 11-20-34 4-24-35 5-3-35 5-11-35	6 mos	Neg 20 m u Neg Neg 20 m u 20 m u	Negative Negative Less than 50 m u Less than 50 m u	No hot flushes Menses at long irregular intervals
17	31	28	Pregnancy term, Disproportion right cystic ovary	Normal until pregnancy	Supravaginal hysterectomy postcaesarean right salpingo-oophorectomy	10-6-31	10-31-34 11-7-34 11-28-34 12-6-34	3 yrs 1 mo	Less than 10 m u Neg Neg Neg	Negative Negative	Hot flushes after operation, disappeared

50 mouse units, which is believed to be an indirect indication of a certain ovarian deficiency

Five of the 8 cases with total hysterectomy (Cases 1, 3, 4, 5, 7) showed "hot flushes," in Case 7 starting as early as 4 weeks, in Case 3, 6 weeks, and in Cases 5 and 1, 3 and 4 months after operation, respectively. In 3 of the cases with "hot flushes," Cases 1, 4, 5, the estrin level was lowered, at the same time the prolan level was raised. In Case 3 the estrin output seemed virtually normal, but one urine specimen showed increased prolan. One patient, Case 7, presented "hot flushes" in spite of showing 40 mouse units estrin, and prolan-A

of less than 50 mouse units in two urine specimens

Table II presents 9 cases of supravaginal hysterectomy between the ages of 22 and 38. The time lapse between operation and first hormone assay varied from 6 months in Case 16 to 10 years 1 month in Case 14.

The estrin output was virtually normal in 4 cases, Cases 9, 11, 12, 13, diminished in 4 cases, Cases 10, 14, 15, 16, and practically absent in 1, Case 17. It is interesting that Cases 11 and 12, aged 35 and 36, showed a good estrin output of from 20 to 80 mouse units daily, 6 years 5 months and 4 years 9 months respectively after supravaginal hysterectomy.

TABLE III

Case	Age time of hormone assay	Age at operation	Diagnosis	Menses	Type of operation	Date of operation	Date of hormone assay	Time between operation and first hormone assay	Result of assay		Free clinical symptoms
									Estrin	P: A	
8		37	Fibroids	Normal	Supravaginal hysterectomy	5-3-33	6-30-33 8-5-33	3 mos.	5 m.u. 60 m.u. 60 m.u.	None died	No hot flushes
9		37	Right type plastic oophorectomy Cystic left ovary	Menstrual irregular	Supravaginal hysterectomy with moving high vary	5-3-33	8-3-33 9-3-33 9-7-33 10-1-33	3 1/2 m.	60 m. 80 m. 60 m. m.u.	None irregular None less than 5 m.u.	No hot flushes Regular menses
10			Fibroids Hyperplastic endometrium	Regular menses	Supravaginal hysterectomy	5-2-33	8-20-33 9-5-33 9-7-33 9-14-33	3 1/2 m.	None None None 5 m.u.		Hot flushes regularly Regular menses before
11		38	Fibroids	Menorrhagia	Supravaginal hysterectomy	6-1-33	10-3-33 10-5-33 10-7-33 10-14-33	3 1/2 m.	None None None 5 m.u. Used		No hot flushes, disappeared regularly

Four of the 9 cases (Cases 9 10 13 15) showed an increased prolactin output of at least 50 mouse units 2 of these (Cases 10 15) showed at the same time a diminished output of estrin

In Case 15 we observed the beginning of hot flushes at the age of 37 7 years after supravaginal hysterectomy and left salpingo-oophorectomy At the same time we observed the hormone picture typical of established menopause Aside from this case hot flushes were noted only in patient Case 17 In the latter complete ovarian and pituitary failure were apparent Supravaginal hysterectomy and right salpingo-oophorectomy had been performed on this patient after caesarean section but unquestionably the remaining ovary had ceased functioning at the time of hormone assays 3 years 1 month following operation At that time hot flushes previously complained of had also disappeared

In Case 16 aged 22 years a supravaginal hysterectomy had been performed after caesarean section with retention of 2 healthy ovaries Six months after this operation estrin was found to be absent in 2 of 3 urine specimens without a corresponding increase of prolactin We examined this patient again 5 and 6 months later and found in each of the two last specimens 20 mouse units of estrin showing an improvement of the ovarian function

Table III shows 4 cases of supravaginal hysterectomies between the ages of 40 and 46 years Case 21 aged 46 showed the hormone picture of the last stage of menopause 8 years after hysterectomy Hot flushes from which the patient suffered previously had disappeared Case 20 aged 45 presented the hormone picture of menopause 2 years 3 months after operation Up to the time of the hormone assays this patient had shown traces of regular menstruation She first experienced hot flushes at the time of an expected menstruation which failed to occur and has since suffered from hot flushes with exacerbations at regular intervals

Case 18 aged 40 years showed excellent estrin output 2 years 10 months after operation Case 19 aged 40 years showed in one of the urine specimens of the first series of four 160 mouse units and 40 to 80 mouse units in the three other ones She had still regular menses 3 years after supravaginal hysterectomy with retention of one cystic ovary Two other hormone assays 5 and 6 months following the first study showed still 40 mouse units of estrin in each specimen The study of this case also supports our contention brought forth in discussing Case 8 that the functional potency rather than the amount of retained ovarian tissue determines the hormone picture and clinical symptoms after hysterectomy

## DISCUSSION AND COMMENT

In our first table we observed the profound influence of total hysterectomy on the hormone picture and the vasomotor system. The average age of the patients was 36 years. In spite of the fact that 7 of the 8 cases were examined as early as 3 months, and not later than 1 year 11 months after total hysterectomy, and only 1 case as late as 3 years 3 months after operation, the average time elapsed being less than 17 months for the 8 cases, we found an increase of prolactin in 6, and a definite diminution of estrin in 3 of the 8 cases. Five cases presented "hot flushes," 4 of these starting as early as 1 to 4 months following operation.

In comparison with the 8 cases of total hysterectomy, the 9 cases of supravaginal hysterectomy of the second table show a different hormone picture and clinical symptoms. The average age was 33½ years. Eight of the 9 cases were studied from 3 to 10 years after operation. The average time elapsed between operation and first hormone assay was more than 4 years 9 months, more than 3 times as long as the average time of 17 months for our series of total hysterectomies.

In spite of the length of time elapsed since operation, 4 of the cases with supravaginal hysterectomy still showed normal estrin output. Case 11 showed in one urine specimen as much as 80 mouse units 6 years 5 months following supravaginal hysterectomy. In 5 cases estrin output was diminished. Only 4 showed increase of prolactin. Only 2 presented "hot flushes," in 1 case starting 7 years after operation. One patient showed indications of menstrual flow.

Even in 2 patients 10 years of age (Table III), we see a normal, or better than normal, estrin output, and no prolactin, 3 years after supravaginal hysterectomy.

Considering all points, the contrast between the hormone picture and clinical symptoms after total and after subtotal hysterectomy is impressive and striking. In the majority of the total hysterectomies we observed a rapid increase of prolactin and a less rapid decrease of estrin. "Hot flushes" occur almost immediately following the operation. Compared with this cases of supravaginal hyster-

ectomy show much less violent changes of the hormone picture, occurring more gradually, and in the majority of cases appearing after a period of several years. "Hot flushes" occur also much less frequently and much later after supravaginal hysterectomy.

If we summarize the cases in our three tables with reference to occurrence of "hot flushes," without considering the ages of the patients, and attempt to co-ordinate the appearance of "hot flushes" with the known clinical facts and with the corresponding hormone pictures, we note the following:

At the time of our investigations "hot flushes" were present in 7 of 21 cases. In addition, 2 patients reported having experienced "hot flushes" previous to the hormone assays. In 6 of the 7 cases exhibiting "hot flushes," prolactin was increased, in 5 of them the estrin output was relatively diminished but not entirely absent. In 2 it was found to be within the general average. These observations correspond with similar findings of Tamis. Only one case presented "hot flushes" in spite of apparently normal findings of both estrin and prolactin.

Three of our 13 cases of supravaginal hysterectomies which showed menses after operation did not develop "hot flushes" during the period of menstrual function.

Among our 8 cases of total hysterectomies we found 5 manifesting "hot flushes" of 6 showing an increase of prolactin. However, among 13 cases of supravaginal hysterectomies we found only 2 presenting "hot flushes" of 6 with a high prolactin level at the time of our investigations.

These findings indicate first that the increase of prolactin is not necessarily associated with the production of "hot flushes," second, that with an equal rise of the prolactin level "hot flushes" are more apt to occur in cases of total hysterectomy than in cases of supravaginal hysterectomy.

It seems that "hot flushes" are more likely to develop the more abruptly the uterine function and the normal utero-ovarian-pituitary balance are disturbed as it occurs in total compared with supravaginal hysterectomy.

We were surprised to find in our second and third series how long the ovary can continue

to function after supravaginal hysterectomy. We see normal quantities of estrin in two women 35 and 36 years old more than 4 and 6 years following supravaginal hysterectomy. This and our other observations contradict the contention of Holak that the life of the ovary after hysterectomy averages only 2 years (at least so far as cases of supravaginal hysterectomy are concerned).

One of the great difficulties precluding general conclusions concerning the influence of hysterectomy on ovarian function springs from the fact that hysterectomy is rarely ever performed without pre-existing pelvic pathology involving uterus and ovaries and in directly the pituitary gland. Even if a uterus is removed after caesarean section as in two of our cases we must consider the profound changes made by the pregnancy on ovaries and pituitary gland. And there is some basis for the supposition that the loss of the uterine body in these cases may retard the return of the sex glands to their normal function possibly by inducing the persistence of the corpus luteum.

It is also likely that other pathological conditions for which hysterectomy was performed may influence the postoperative hormonal picture. For instance Aschheim and Zondek report that in a considerable percentage of the cases with uterine fibroids they found an increase of prolactin in the urine prior to any interference—an observation which we have also made in a limited number of cases.

And we are not sure whether this tendency to a high prolactin output may not persist after removal of the fibroids and account in part for the numerous findings of high prolactin after hysterectomy.

We already have mentioned 2 of our cases in which ovarian cysts and hyperplasia of endometrium were found during operation. In spite of preservation of only one and only half of one cystic ovary respectively a condition of hyperestrinism persisted 1 and 3 years afterwards as it undoubtedly had existed before operation.

#### CONCLUSIONS

By reason of the limited number of our cases and the insufficient period of our ob-

servations we feel able to make only a few general conclusions.

1. There is a striking contrast between the hormonal picture and occurrence of hot flushes following total hysterectomy and supravaginal hysterectomy. The hormonal picture and clinical symptoms of menopause appear earlier and more marked after total hysterectomy than after supravaginal hysterectomy.

2. The preservation of even a small part of the uterus seems to have a retarding and mitigating effect upon the appearance of retrogressive changes in the pituitary-ovarian function and the occurrence of menopausal symptoms.

3. Our studies seem to support the theory that the uterus elaborates a catalytic principle acting upon some part of the pituitary-ovarian hormonal mechanism regulating its normal balance and functional harmony.

4. The amount of estrin output after hysterectomy is determined more by the biological quality than by the amount of ovarian tissue retained.

5. Occurrence of hot flushes after hysterectomy is associated in nearly every instance with an increase of prolactin and in the majority of cases with a decrease of estrin.

6. In a few cases manifesting hot flushes average amounts of estrin and in rare instances normal prolactin may be found. On the other hand diminution or even complete absence of estrin and increase of prolactin occurring independently or together are not necessarily associated with hot flushes.

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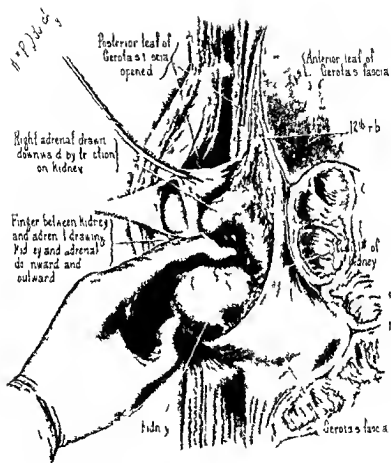


Fig 6. Right adrenal gland drawn downwards by traction on kidney. Finger between kidney and adrenal drawing kidney and adrenal downward and outward.

# CLINICAL SURGERY

FROM THE JAMES BUCHANAN BRIDGES UROLOGICAL INSTITUTE

## A TECHNIQUE FOR SIMULTANEOUS EXPOSURE AND OPERATION ON THE ADRENALS

HUGH H. YOUNG, M.D., F.A.C.S., BALTIMORE, MARYLAND

OPERATIVE intervention in cases of disease of the adrenals has assumed an important place in the literature in recent years. Great advances have been made in the study of the physiology, secretory activity, and pathology of the adrenal, and its amazing association with abnormalities of the genital system. Since Gordon Holmes' publication of a case of virilism, in which the removal of a tumor of the adrenal was followed by a striking disappearance of hirsutism, mammary atrophy, and hypertrophy of the clitoris, there have been many reports of surgical attack of the adrenal. In the very extensive literature which is now to be found on the subject, one finds many extraordinary cases. Remarkable restorations to normal have followed the removal of benign and malignant tumors of the adrenal. Broster has reported many cases of adrenal hyperplasia associated with masculinization in previously normal women. By means of unilateral adrenalectomy, great improvement is reported to have followed in some of his cases. Recent articles by Crile, Goldzieher and Koster, Walters, Cahill, and others have increased the interest in the surgery of the adrenals. Their articles, however, show marked difference of opinion as to the proper method of approach and the technical details of the operation.

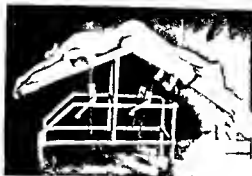
Crile says "In several cases, with the patient in the prone position on the table, we have made the approach along the lumbar muscles through a vertical incision, believing that in this way we would approach the gland on its posterior aspect and by a shorter route. The special advantage of this method was that the nerves and blood vessels could be seen more directly, but the procedure had limitations due to the position of the patient on the table.

"We have also made a vertical incision toward the anterior aspect of the adrenal along the tip of the twelfth rib, but this method entailed too much contact with the peritoneum.

"Recently, our method has been to make a modified kidney incision. This incision, running from behind forward, terminates at about the middle of the twelfth rib, and is carried down vertically. The incision must be large enough to admit the hand into the renal space. Every bleeding point must be securely tied before the deeper dissection is begun. Since good exposure is essential, by means of a right-angled retractor, the twelfth rib is raised and the bloodless field is disclosed. After the renal fascia has been adequately incised, a long vessel may be seen in the renal fat, the vessel which, as stated above, marks the trail to the adrenal gland. The first step is to mobilize the upper pole of the kidney and to depress the entire kidney when usually the yellow curved edge of the adrenal pancake may be seen. If the adrenal is not seen, the hand is introduced, and by palpation toward the vertebral column and the great abdominal vessels, the external ear-like border of the adrenal will be felt."

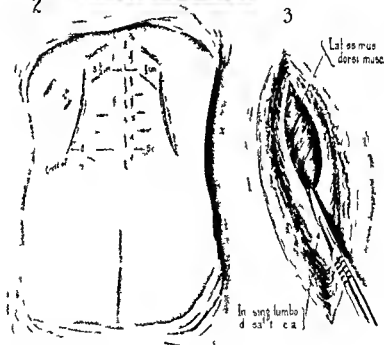
Crile, in speaking particularly of denervation of the adrenals, says "If the first denervation produces none of these beneficial results, it will be because the diagnosis is incorrect. In correctly diagnosed cases the second denervation will be followed by further improvement" (i.e., a second operation on the opposite side).

In speaking of operations for adrenal hyperplasia, Goldzieher and Koster say "The operative treatment consists of the partial removal of the glandular structure. This can be done by removing either one adrenal or doing subtotal bilateral adrenalectomy. Since both adrenals must be inspected to avoid overlooking adenoma, single or multiple, and since the exposure of the left adrenal is slightly simpler, the right one is approached first. Spinal anesthesia provides a maximum relaxation. The patient is placed in the position which the operator considers most favorable for an extraperitoneal approach to the kidney. Our incision extends from the tip of the



2

3



W. P. Jones, 1936

Fig. Of rat f. multa pos. a d. mpa. iso. fad. l. r. P. t.  
 f. patient chest d. p. l. s. pp. i. d. a. th. k. p. d. b. d. m. d. p. p. d. z. B.  
 lat. l. a. h. d. f. med. an. l. j. D. ff. sc. a.

twelfth rib obliquely to the anterior superior spine down through the muscular wall and fascia to the perirenal fat. The peritoneum is now opened and both ovaries are palpated and inspected. In the absence of any ovarian tumor the peritoneum is closed. The fatty capsule is then opened, the kidney is thoroughly mobilized to the same extent necessary to accomplish a nephrectomy comfortably, and it is then dislocated down

ward and anteriorly. It is covered by a lap sponge and retracted by a flexible retractor. The fingers are now introduced toward the diaphragm into the fat, which is found above the former situation of the upper pole of the dislocated kidney and the adrenal is located by its granular feel. The fat is stripped from it by stick sponges, and it is thoroughly inspected and palpated for both gross enlargement and adenomatous undulations on

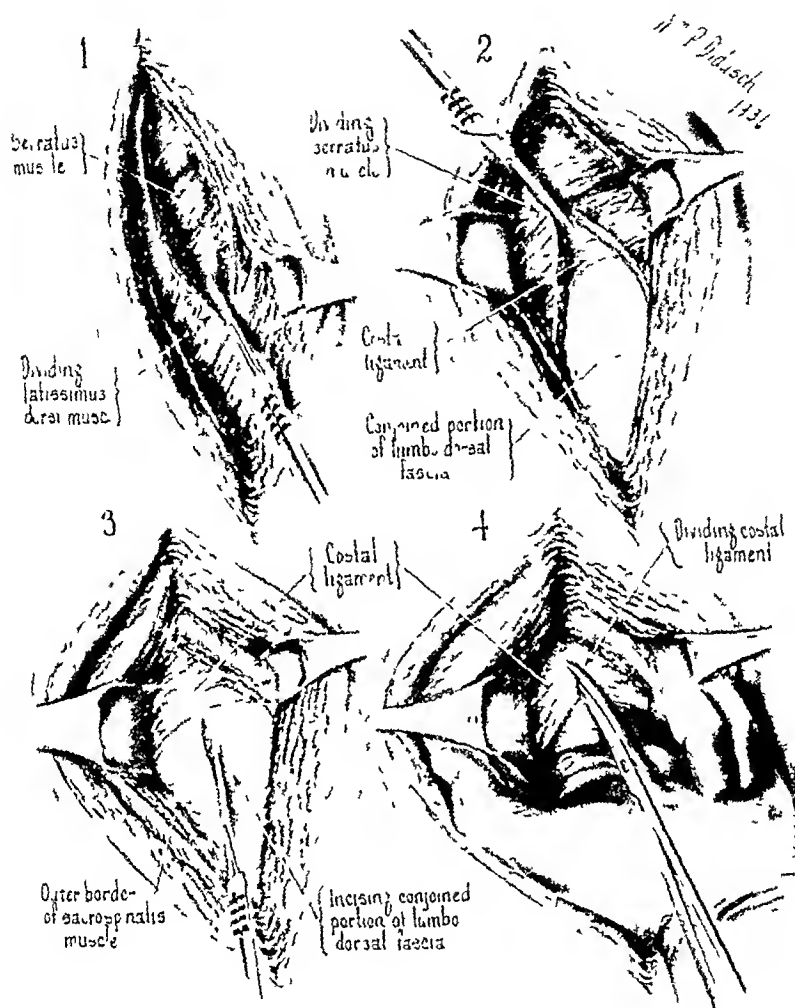


Fig 2 1, Division of latissimus dorsi 2, Division of serratus magnus 3, Incision of lumbodorsal fascia 4, Division of costovertebral ligament

the surface. If a solitary tumor is found, it should be shelled out. If this is not possible, the gland should be removed. After double ligation of the upper vascular pedicle (inferior phrenic branch) and section, the ligature on the distal side is used as a tractor by means of which the progressive freeing of the posterior and anterior surfaces and inner border of the gland is facilitated. The hilus is then seen with the main vascular pedicle. The latter is ligated and the gland is cut free. A cigarette drain is placed down to the perirenal fat to the upper pole of the kidney, which is replaced in its bed, and the wound is closed in layers. If no

tumor has been found, a similar procedure is carried out on the left side. If inspection here fails to reveal a tumor, the presumptive diagnosis is adrenal cortical hyperplasia and the left adrenal is then removed, as previously described. In very obese patients it may become necessary to remove the twelfth rib in order to obtain an adequate exposure. This procedure was necessary in one of our cases.

"Five cases of adrenal cortical hyperfunction treated surgically by unilateral adrenalectomy have been described. Four of the patients were benefited, and one died."





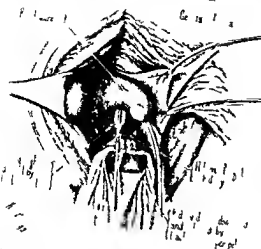


Fig. 1. Key and n d ut nh t t  
ad nal be ogf d

Fig. 2. Left dren l has b n xpo d by tech i  
s mfa to th t mpl y d n i post e d

or intravenous urogram or after air has been injected within the perirenal fascia has proved far from conclusive in various cases. Some operators frankly admit that before determining what should be done the position of the patient must be changed so that lumbar incision may be made on the opposite side to explore the other adrenal. Such a procedure was employed in several of my cases. With the patient lying on one side by means of a typical curved renal incision one adrenal was exposed. Then the patient was turned over on the opposite side and the other adrenal was exposed. Careful measurements were made on each side and I was able to determine what operative procedure should be undertaken but these methods have proved difficult to carry out and time consuming. It seemed evident that if the patient the operative procedures would be greatly facilitated. I wish herewith to present a technique which I have found very satisfactory for simultaneous bilateral exposure study of and operation upon the adrenals.

#### OPERATIVE TECHNIQUE FOR SIMULTANEOUS EXPOSURE AND STUDY OF THE ADRENALS

The patient is placed face downward upon the table with a pad beneath the chest and another beneath the pelvis and lower extremities (Fig. 1). The abdomen drops down between. An incision is made first in the right back beginning 5 centimeters from the median line and about

3 centimeters above the last rib. From there it is directed downward and outward to a point 8 centimeters from the median line to the crest of the ilium (Fig. 1). With an expert assistant the left side may be operated upon simultaneously and valuable time thus saved. The incision is carried through the fat and fascia, exposing the latissimus dorsi muscle (Fig. 1, 3) which is divided completely (Fig. 2, 1) thus exposing the serratus magnus muscle which in turn is divided (Fig. 2, 2). The incision is carried upward not only through that portion of the muscle which goes to the twelfth rib but also through that which goes to the eleventh rib, thus exposing a large area of the costovertebral ligament (Fig. 2, 3). An incision is then made through the conjoined portion of lumbodorsal fascia just external to the outer border of the sacrospinalis muscle (Fig. 2, 3). By blunt dissection the tissues are freed from the being taken to avoid tearing into the pleura by going somewhat toward the spinal column. A finger is then inserted and the costovertebral ligament is divided for at least 4 to 5 centimeters (Fig. 2, 4). This completely liberates the twelfth rib and allows it to be drawn outward and forward to such an extent as to afford an excellent view of the structures beneath. By the free division of muscles and the costovertebral ligament described we have found it unnecessary to resect the last rib. In most patients a layer of more or less considerable retroperitoneal fat next encountered. This is stripped off thus exposing the fascia which surrounds the kidney and ad



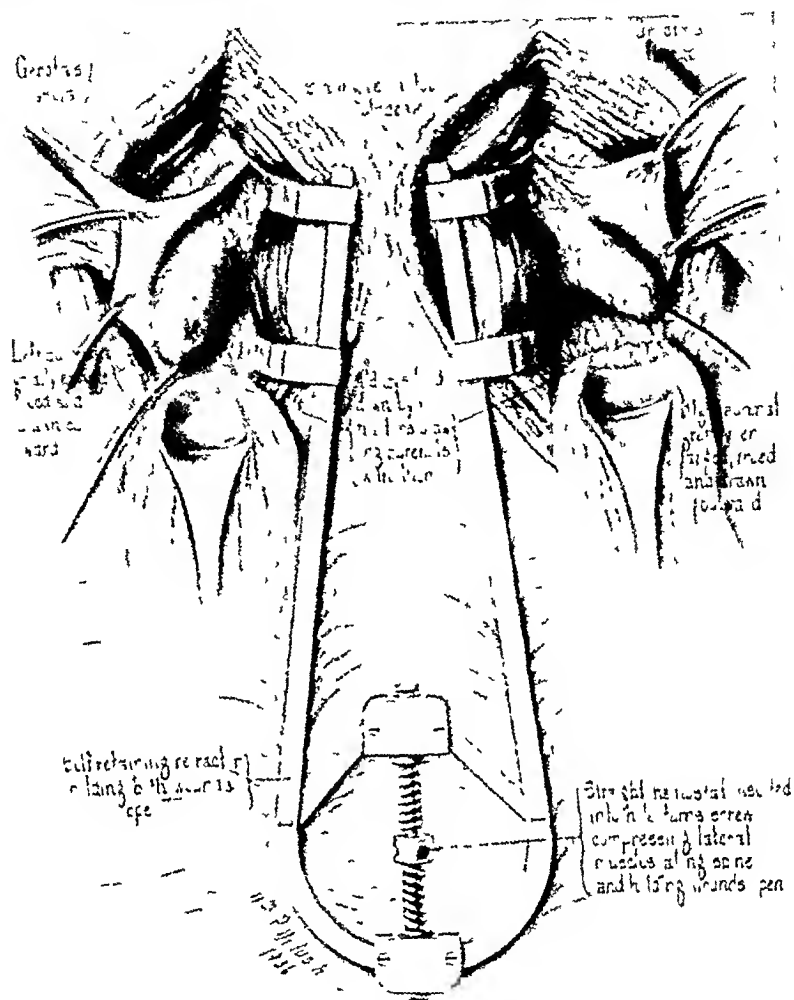


Fig 9 Special double retractor used to draw spinal muscles together for simultaneous exposure of both adrenals

renal, and is usually known as Gerota's fascia (Fig 3). This fascia is stripped away from the outer edge of the quadratus lumborum muscle, and, in most patients, it is then possible to see the kidney and also the adrenal through the thin fascial covering. In fat patients this is not possible, but they both may be easily recognized by palpation. A tear is then made through Gerota's fascia at a point between the kidney and adrenal and the wound is enlarged and opened out, thus exposing structures within the capsule, the adrenal above and the kidney below (Fig 4). The adrenals lie immediately above and in close ap-

position to the kidneys (Fig 5). They are held in this position by the dorsal veins, which come off from the renal pedicle (Fig 5). In Figure 5, B, the relation of the adrenal to the fascia renalis (Gerota) and to the kidney is graphically shown on section. The finger is easily pushed inward between the adrenal and kidney until the hilum is reached (Fig 6). By making traction downward and outward, and also with the assistance of clamps on the fascia, the adrenal is drawn toward the surface of the wound. In young, thin patients we have actually been able to make the adrenal almost touch the skin. In this position, by means



Fig. 10

Fig. 10. Full exposure of the uterus and ovaries. The uterus is held in position by the clamp.



Fig. 11

Fig. 11. Exposure of the uterus and ovaries. The uterus is held in position by the clamp.



Fig. 12

Fig. 12. Exposure of the uterus and ovaries. The uterus is held in position by the clamp.

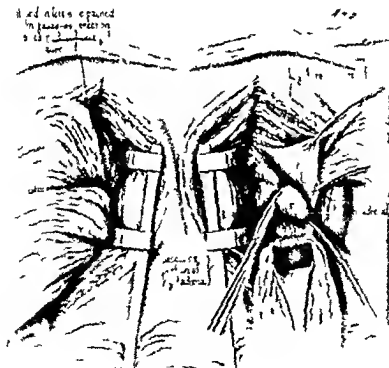


Fig. 13. Exposure of the uterus and ovaries.

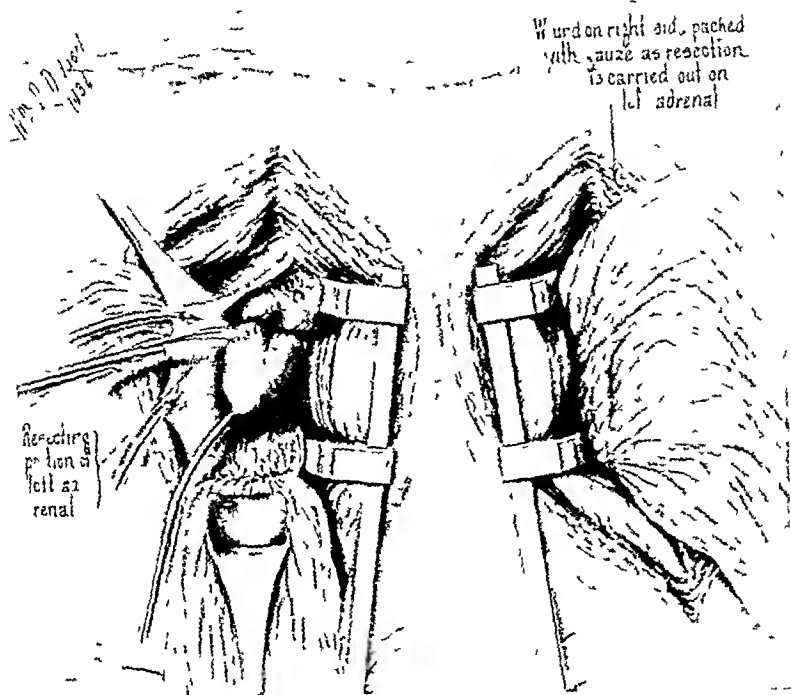


Fig. 14. Excision completed

of the Kuttner dissector, the adrenal may be easily separated from surrounding fat and adhesions (Fig. 7) while the kidney is being drawn downward and outward by a retractor. Having thus exposed the adrenal completely, a careful survey is made to determine the presence of pathological conditions (adenomas or other tumors, hyperplasia, etc.). Even though a pathological condition deserving of surgical attack is present, it is certainly not safe, in many instances, to proceed without seeing and carefully examining the opposite adrenal. I, therefore, proceed to expose the left adrenal by the same technique described for the right. As stated above, it may sometimes be advisable to have an assistant surgeon work upon the left side while the operator is exposing the right adrenal. Having now satisfactorily exposed both adrenals, a special retractor recently designed for this work is introduced (Fig. 8). As seen here, by means of a double-acting screw the retractor blades, which slide upon the lateral bars, can be forcibly approximated so as greatly to compress the spinal muscles (sacrospinalis and quadratus lumborum) on each side, and thus greatly enlarge the wound. It is then possible to compare accurately the two

adrenals to determine the pathological conditions present, and to decide what should be done surgically. In the case herein depicted, the drawings of which were made at the operating table by Didusch, both adrenals were found to be markedly hyperplastic. The surfaces were somewhat irregular, but there was no evidence of adenomas or other tumors. The condition was typical of that described by Broster and Vines as responsible for the sexual abnormalities present in this case (hirsutism, lack of mammary development, masculine voice and bodily hair distribution, hypertrophied clitoris, and a vagina opening into the urethra). It was decided accordingly to remove a considerable portion of each adrenal. Figure 10 shows the ligation of the right adrenal, and Figures 11 and 12, the excision. On the left side the adrenal was larger and broader, and it was decided to place two ligatures after puncturing the adrenal with a curved clamp (Figs. 12 and 13). After having arrested all bleeding points, the wound was closed with cigarette drains emerging from the upper angle of the wound (Fig. 14), the muscles and fascia being approximated in layers.

The postoperative treatment is similar to that employed by various operators after adrenalectomy.



Fig. 1. Clef and 13 ribs th alig rig  
ette dr sat upper angle

tomy. A drop in blood pressure and a rise in pulse may for a time be quite disturbing but my patients have responded to stimulation by adrenalin and the use of intravenous infusions of 5 per cent glucose and in one case a blood transfusion.

Bilateral resection of the adrenals has now been carried out in 5 cases and the technique here described has apparently been entirely satisfactory. There has been no case of gross tumor among these cases but I am confident that through the same incision a tumor of considerable size could easily have been removed extraperitoneally. Should the operator wish to explore the peritoneal cavity on one side little difficulty would be experienced in so doing and in carrying out intraperitoneal operation. Should the adrenal tumor be very large it might be desirable to

enlarge the incision along the costal border but because of the very large exposure obtained by the use of the muscle compressing retractor and the liberation of the twelfth rib on each side by division of the costovertebral ligaments I believe that the exposure would be entirely satisfactory in almost all cases including adrenal demerolization.

#### CONCLUSIONS

The rapid growth of interest in diseases of and surgical attack upon the adrenals has been stressed. The great desirability of exposing and comparing the two adrenals before carrying out surgical operations upon one or both of them has been emphasized. The unfortunate results from previous inability to visualize the two adrenals except by clumsy technique in which the patient is operated upon first on one side and then turned over and operated upon on the other have been cited. A plan of operation in which the patient is kept in one position on his face and the two adrenals exposed for simultaneous examination and decision as to the operative attack has been described in detail with numerous drawings which were made at operation by Didusch. Very satisfactory results have been obtained in the cases in which this technique has been employed.

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FROM THE MEMORIAL HOSPITAL FOR CANCER AND ALLIED DISEASES  
THE TECHNIQUE OF GASTRIC RESECTION FOR CARCINOMA<sup>1</sup>

## A CRITICAL REVIEW

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AFTER very thorough research into the medical literature Finney and Rienhoff give credit for the first conception of gastric resection to "a certain famous professor, highly respected and renowned among the medical profession of Philadelphia." This statement is based on the authority of Merrem of Giessen who, in 1810, contributed a monograph entitled "Certain Surgical Operations and Experiments on Animals, Illustrated by Facts." Although the name and source of the information could not be discovered, they believe, after study of all available data and comparison of dates, that the famous surgeon alluded to was John Jones, a native of Philadelphia who was the first professor of surgery in King's College, New York. Merrem's experiments on dogs led him to the conclusion that pyloric resection was possible, his criteria of operability would be acceptable today.

Practically all authors ascribe the experimental work of Gussenbauer and Kaiser, performed 66 years after that of Merrem and almost a century after that of John Jones, as the basis for resection of the human stomach. The first pylorotomy in man is generally credited to Péan and was performed on April 9, 1879. He removed the pylorus, closed the lesser curvature, and anastomosed the duodenum to the cut end at the greater curvature. Péan, however, in his article states that "a confrère of Arras" had done a resection before him for a tumor of the gastric pylorus. Péan's patient died of the operation as did the patient of Rydygier on whom a gastric resection was done the following year. Rydygier, on November 16, 1880, resected the pyloric segment of the stomach with 3 centimeters of the duodenum and did an end-to-end anastomosis.

Billroth had the distinction of performing the first successful partial gastrectomy on February 13, 1881. He was quoted in 1877 as speaking about the operation of gastrorrhaphy for a fistulous opening in the stomach thus: "From this operation to the resection of a piece of carcinomatous stomach there is still only a bold step to be taken." His early operative mortality was 64 per cent. In 1881 Woelfler, Billroth's assistant, reported 3 cases in which successful pyloric re-

sections had been performed and 1 case in which he was unable to do a resection, but in which the first gastro-entero-anastomosis was performed anterior to the transverse colon. Von Stacker, in 1885, did the first posterior gastro-enterostomy.

## GASTRIC RESECTIONS, SUBTOTAL

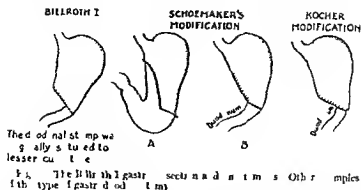
*Billroth I.* In the first 2 gastric resections, which were performed by Péan and Rydygier, after the gastric segment had been removed with more or less of the duodenum, the duodenal end was sutured to the cut gastric stump near the greater curvature after the additional opening near the lesser curvature was closed. In Billroth's first 2 cases the duodenum was sutured near the lesser curvature, thus more nearly restoring the normal physiology (magenstrasse) and requiring less mobility of the duodenum. He later changed to the method used by his predecessors because (a) the emptying of the stomach was better when there was no dependent pouch, (b) there was no fear of a diverticulum on the lesser curvature side, and (c) the suturing was less difficult. Rydygier noted this point in an article in which he claims priority to Billroth. Rydygier also made a point of the fact that he used a midline incision while Billroth first used a right rectus exposure, later changing to the midline.

The operation which is referred to as the first method of Billroth is one in which there is an end-to-end anastomosis of the duodenum with the inferior portion of the gastric stump (Fig. 1). Its advantages may be cited: it is the most nearly physiological reconstruction of the gastro-intestinal tube, the cardiac portion of the stomach can be mobilized by stretching and dividing the retaining bands posteriorly (Horsley). We have found that the duodenum can usually be mobilized without great difficulty, a procedure that is of great assistance in effecting such an end-to-end anastomosis without undue tension. The disadvantages outnumber, however,

1. There is danger of leakage at the so called "deadly triangle."

2. It is difficult to bring the duodenal end to the gastric stump if the resection has been wide. A narrow excision for carcinoma, unless the tumor

<sup>1</sup>From the Memorial Hospital for Cancer and Allied Diseases and the Strang Tumor Clinic of the New York Infirmary for Women and Child.  
Aided by a grant from M. Lucius N. Littauer.



very early and small is worse than useless. The surgeon who consistently uses this operation may be too conservative in the amount of stomach resected in order to effect an anastomosis.

3. The danger of tension on the duodenum is ever present.

4. Some difficulty is experienced in suturing the thick wall of the stomach to the thin one of the duodenum.

5. If the carcinoma recurs locally it may cause pyloric obstruction, a complication that is less frequent in the modifications of Billroth's second operation.

*Schoemaker's modification.* This method which makes use of a special large curve clamp is applied rather frequently in Europe. It allows the removal of a large portion of the pylorus and a lesser curvature which is the dangerous area for gastric ulcer, but it is doubtful if the amount removed is sufficient to warrant its application for cancer.

Kirschner describes a tubular resection method which is very similar. He does not mention the use of Schoemaker's clamp. The tubular resection may be completed by gastroduodenal anastomosis or both stumps may be closed and a gastro-enterostomy performed.

The chief advantage of either method seems to be that the long tubular stomach thus formed may be sutured to the duodenum without tension even though a lesion high on the lesser curvature has been excised (Fig. 1). Tauchet accomplished a similar result for ulcer high on the lesser curvature by excising the usual prepyloric segment and then a second curved segment of stomach on the lesser curvature where the ulcer was situated. He closed the superior diagonal portion then sutured the gastric and duodenal ends together or did an end-to-side anastomosis with the jejunum by the method of Joly. This method is not advocated for cancer.

*Kocher modification.* Kocher developed this method after he had done 16 cases following the Billroth I technique and 2 by Billroth II with a 66 per cent mortality. He then closed the gastric stump entirely and sutured the duodenal end into the gastric wall making a new stoma usually on the posterior wall but occasionally on the anterior (Fig. 1). He claimed that his mortality rate was only 16 per cent after thirty such operations. In describing the method the author stressed the fact that there must be rigorous aseptic continuous sutures must be used throughout and good clamps are absolutely necessary. He used the Murphy button where there was any tension. This device was in common use at that time for gastro-intestinal anastomosis.

The advantages of the Kocher modification are as follows:

1. There is less danger of sealing the suture line than in the Billroth I method.

2. Hendel (of the Czerny clinic) claims that it restored the anatomical relations better than the other methods.

The Kocher operation has been rather generally discarded (H. F. L.). The disadvantages are considerable.

1. It is impractical for the performance of extensive resections.

2. There is danger of leaving too much stomach in order to effect an approximation of the two ends which really requires overlapping.

3. The posterior wall is often inaccessible because of a lesion making the posterior suture very difficult to place.

4. The danger of infection of the suture placed deeply posterior is great.

*Halber's innervated modification.* Halber termed this method a termino-lateral gastro-duodenostomy. It consists after removal of the pyloric segment of closing the duodenal end and bringing the ileum up to anastomose with the gastric remnant.

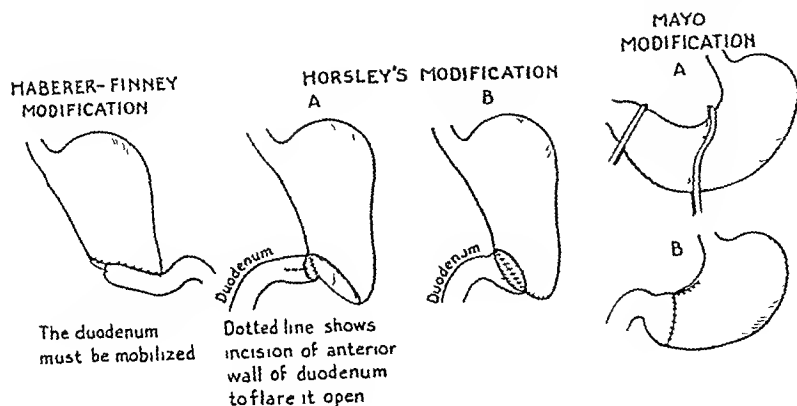


Fig. 2 Other modifications of the Billroth I procedure The technical details are described in the text

ing (Fig. 2) It is said to have all the advantages that Billroth I has over Billroth II with no danger of jejunal ulcers. It may be possible to mobilize the gastric stump somewhat but the success of the operation depends upon the successful mobilization of the duodenum. The ampulla of Vater always has lain directly opposite the new gastroduodenal stoma.

This method has had several disadvantages pointed out and objections raised. It is difficult to perform if there is much fat in the mesentery or in cases with ulcer where there is periduodenitis. The clamps must be applied very near the newly closed end of the duodenum and may disturb it. Haberer never found this harmful and he points out that the use of a clamp may not be necessary if the costal arch is high and broad. Some have objected to the procedure saying that there is traction on the anastomosis, but this pull is said to disappear when the clamps are removed. The patient usually vomits bile the first day after operation but the vomiting is no worse than after a cholecystgastrostomy and never persists. We ourselves have had no experience with this operation.

**Mayo modification** Mayo also devised a special curved clamp for partial gastric resection which enabled him to resect higher on the lesser curvature than was usually done. He then closed the upper curved part and anastomosed the gastric ends as is done after a sleeve resection (Fig. 2). Mayo laid stress on the division of the viscera and omentum with the actual cautery to avoid the dissemination of cancer cells. The chief objection to this technique is the limited number of cases to which it is applicable.

**Horsley modification** This technique varies from the first method of Billroth in that an in-

cision is made down the anterior aspect of the duodenum, parallel to the canal and at right angles to the transverse duodenal incision which it joins, it is flared open and made almost large enough to fit into the gastric opening. A few stitches are placed near the greater curvature, but otherwise the width of the stoma corresponds to that of the proximal gastric incision (Fig. 2). It is the most perfect physiologically since Billroth's early cases, because the peristaltic wave carries the food down along the lesser curvature and directly into the duodenum. Horsley claims that convalescence is smoother because the stomach empties well. This Horsley operation is a decided improvement over the other modifications of the Billroth I procedure, and, in the hands of its master originator, is suitable for the majority of carcinomas situated in the distal third of the stomach.

**Billroth II** By the creation of his second method Billroth made possible the removal of many tumors which were not previously resectable. Billroth did a gastro-enterostomy first and then excised the tumor bearing segment. This order has been reversed and many other variations used since the original operation (Fig. 3). The principal factors in the variations consist of the following: (1) treatment of the gastric stump, (2) special opening for the anastomosis, (3) location of this opening, (4) position of the jejunal loop with reference to the colon and transverse mesocolon, (5) treatment of the jejunum, and (6) direction of the jejunum.

The advantages of the second method of Billroth and the modifications of this method of procedure over the first method may be enumerated as follows:

1. Wider resection is possible

BILLROTH II



Ant. o. p. t. r.  
gast. l. t. my

POLYA (REICHEL)



Ret. col. c.

BALFOUR



L. g. je. at loop ant. col.  
complem. t. y. t.  
anastom.

MOYNIHAN I



Ant. col.

MOYNIHAN II



Ant. col. loop method

Fig. 3. The Billroth II method after gastric resection and some of the more popular methods of the

2 The difficulty of approximating the segments to re-establish intestinal continuity is not encountered

3 The danger of leakage is less

4 There need be no tension on the anastomosing sutures

5 The Billroth II method is usually done more quickly than Billroth I

6 It can be performed in two stages. We have never considered the two-stage resection to be practical for any operable gastric cancer unless pyloric obstruction (especially in elderly patients) is a predominant feature of the case. It seems best under such circumstances to relieve the immediate danger of continued pyloric obstruction by quickly performing a gastro-enterostomy, reserving the partial resection for cancer to be done at a later date. The Billroth II operation seems best adapted for this particular need.

*Per contra* the emptying time is longer, there is danger of vicious circle formation and in cases where an ulcer is the indication for operation the danger of jejunal ulcer is greater when the gastric contents empty directly into the jejunum. These handicaps are much more significant in the case of ulcer than in carcinomas.

Mayo employed a posterior suture gastro-jejunosomy with the jejunum passing to the left and as short a loop as will reach the stomach pouch without tension. Subsequent to this description however he described his modification of Billroth's first method which has been described above.

*Kruecke's modification* described in 1888 was a foundation for many improvements. The segment of stomach having been removed by a horizontal incision proximally an end-to-side anastomosis was made with the jejunum (Fig. 4). This anastomosis was antecolic. The method was abandoned because the emptying time was too

rapid. As seen in the diagram the proximal loop of jejunum is sutured to the lesser curvature.

*Viklitz's modification* This surgeon in 1898 closed the gastric stump completely and then made a new opening on the greater curvature adjacent to the line of suture. The anastomosis was performed with the jejunal loop drawn up behind the colon through the transverse mesocolon (Fig. 4). The aim of this operation was to provide better drainage without such rapid emptying. In one instance Viklitz successfully utilized this procedure as a two-stage operation.

*Hofmeister-Linsinger modification* These two men working separately excised a large portion of the stomach including almost the whole of the lesser curvature by making a wide oblique superior section. The upper two-thirds of the incision was closed. A loop of jejunum was then brought up through the transverse mesocolon behind the colon and anastomosed to the lower third of the gastric opening (Fig. 4). The direction of the jejunal loop was right to left in contrast with that of Viklitz.

This method allows a wider resection than the second one of Billroth. It requires a shorter jejunal loop than the typical Pilya method and thus lessens the opportunity for kinking and the fear of too rapid emptying is eliminated. The so-called fatal triangle is said not to be dangerous because the continuous catgut suture is made to extend past this point and down to the greater curvature. Horsley prefers this method to the more commonly practiced procedure of Pilya.

*Roux's modification* The Y method (Fig. 5) was originated quite early (described in 1891) and is considered today to have little to recommend it according to Horsley. As seen from the illustrations after closing the gastric stump the jejunum is severed 6 to 8 inches below its origin.



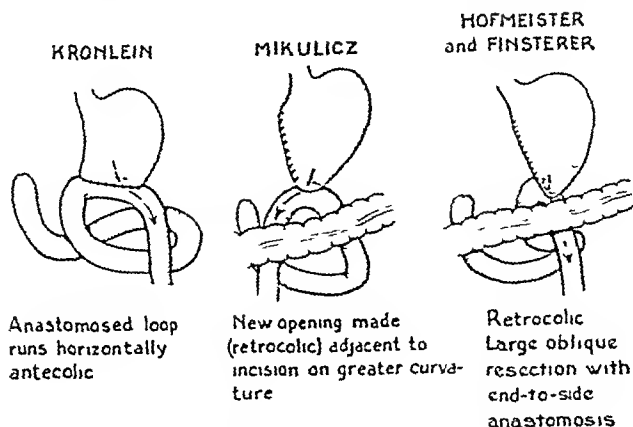


Fig 4 Other modifications of the Billroth II procedure

the aboral end is sutured into the posterior wall of the stomach and the oral end into the side of the jejunum 3 or 4 inches below the gastrojejunal anastomosis (Fig 5)

No advantages are cited for this method in recent literature. It is very limited in usefulness since it can be considered only in extensive resections when it is difficult to bring a jejunal loop sufficiently high or if division of the jejunum is necessary in order to resect a jejunal ulcer.

The chief objection is that the duodenal contents are deliberately shunted away from the stoma of the gastro-enterostomy; the segment of jejunum between the stomach and entero-enterostomy receives only pure gastric juice, predisposing to ulcer formation. The procedure is long and too complicated to be generally practical.

**Pólya method** This modification of the Billroth II principle has been one of the most popular since Pólya's description was published in 1911. His well known method of treating the gastric stump and restoring continuity of the alimentary canal after partial gastric resection is plainly shown in the illustration (Fig 3).

The procedure allows wide resection, in fact Pólya advised its use only after extensive resections. It shortens the technical steps without devitalization of the lower end of the gastric stump as in Billroth II. The serosa is everywhere approximated. The anastomosis is retrocolic, thus preventing the transverse colon from dragging down on the jejunal loop. Kirschner even terms this method and describes it as "the normal procedure."

Some disadvantages and warnings must not be forgotten. There is the possibility of too great tension on the jejunum and constriction of the loop by the transverse mesocolon. Mayo draws

the gastric stump down through the transverse mesocolic opening and sutures it there to eliminate this danger of constriction of the jejunal loop. It is said that the emptying time of the stomach is too short. After a wide resection, it is occasionally impossible to bring the anastomosis to the level of the opening in the transverse mesocolon.

Hartmann used the method of Reichel and Pólya but modified it to some extent. The open portion near the lesser curvature was sutured, thus making the opening somewhat narrower.

Reichel's description of this technique was published in 1908. The method is essentially the same. He stressed the point that the closed duodenal stump should be peritonealized.

The *Balfour technique* is similar to that of Reichel and Pólya in that the side of the jejunum is anastomosed with the end of the gastric stump. However, he makes the anastomosis in front of the transverse colon and mesocolon, leaves a long duodenojejunal loop to prevent constriction of the colon and does a complementary entero-anastomosis (Fig 3).

There is no tension on the colon and no danger of jejunal constriction by the mesocolon. The entero-anastomosis prevents backflow and facilitates drainage of the blind loop which is about 30 centimeters long. Balfour claims that it is "safer, simpler and quicker." "It can be used in practically every case." "Postoperative complications are less, its use is possible in extensive resections."

**Moynihan I and II** Moynihan has described two different techniques of gastric resection in his book, both of which must be considered as modifications of the Billroth II technique. The first method, in which the jejunum is used to close



The flap thus made is retracted upward and the cardia is exposed in a manner which is similar to that obtained by the Baudet-Navarro technique

The technique used by Bier for a case of carcinoma of the cardia and upper part of the lesser curvature will be described. The involved part of the stomach and cardia being freed from adhesions, the stomach was clamped and divided well below the tumor margin. The distal end of the stomach was closed, and again seized by a soft rubber clamp in order to draw it up toward the cardia. Using the segment to be excised, the esophagus and gastric antrum were approximated and the posterior suture placed before the tumor was removed. The esophagus was sutured into the anterior wall of the stomach just below the line of closure in the usual manner. The lesser and greater omenta were then repaired and anchored.

Bier's patient had an unusually long subdiaphragmatic portion of esophagus. This technique, however, should be applicable when a case is considered resectable. The technical difficulties are great. Inasmuch as 20 per cent of the gastric cancers seen at the Memorial Hospital are in the cardia, we have long hoped for an opportunity to perform a cardiectomy. However, in every case so far gastroscopy has shown the terminal esophagus to be involved or the lesion was found otherwise inoperable after exposure of the cardia by the Baudet-Navarro technique.

#### TOTAL GASTRECTOMY

*Historical* After the first total gastrectomy (1884) in man by Conner of Cincinnati which was unsuccessful, several others were performed with the same result. Maydl, in 1892, and Langenbuch in 1894 did extensive resections but they were subtotal. Schlatter of Zurich in 1897 performed the first successful total gastrectomy and anastomosed the esophagus and jejunum. MacDonald did the second and Brigham of Boston the third in 1898. Brigham demonstrated the possibility of duodeno-esophageal anastomosis. Two other successful operations were performed by Harvie and Richardson. Shortly after 1900 a number of cases were reported in succession and complete gastrectomy became a recognized surgical procedure differentiated from subtotal gastrectomy which has been described heretofore. Finney and Rienhoff made an analysis of 67 cases which were recorded in the literature before 1929 that had the cardiac and pyloric sphincters removed with the body of the stomach followed by anastomosis between the esophagus and duo-

denum or jejunum. The operative mortality was 53.8 per cent when total gastrectomy was done. In 55 cases which had less than 3 centimeters of the stomach left the mortality was only 25 per cent.

*Technique* Recent improvements in the technique are two-fold. The first is the prevention of reflux material going from the stomach into the esophagus and the second is suturing the jejunum to the posterior wall of the esophagus before the stomach is removed. This last improvement was introduced by Moynihan and has been widely accepted and used.

A midline incision is made about 8 inches long from the xiphoid to the umbilicus. After exploration the coronary artery is found and ligated. The nodes near the greater and lesser curvatures are left with the stomach when the curvatures are freed to the cardia and pylorus. A clamp is placed across the duodenum an inch below the pylorus. A second clamp is placed above at the cardiac sphincter. The duodenum is cut and the distal end closed. The entire stomach, which has been freed previously, is lifted up and used to pull the esophagus down below the diaphragm. It is usually possible to mobilize at least 1 inch. The jejunum is brought up antecolic and an anastomosis made with the esophagus in the usual manner using the stomach for traction until the posterior suture is placed. The stomach is severed at the cardia and the anterior part of the anastomosis completed.

We have performed only one total gastrectomy which was successfully accomplished without great technical difficulties by using the Marwedel incision (parallel to left costal margin) and then excising the costochondral arch after the method of Baudet and Navarro. This exposure renders the level of the anastomosis easily accessible so that in our case we could anastomose duodenum to esophagus.

Variations in this technique have to do chiefly with different methods of anastomosis. The end of the duodenum may be anastomosed to the end of the esophagus in rare cases where there is a long abdominal portion of the esophagus or the duodenum is unusually mobile. Under similar conditions a terminolateral anastomosis has been done between the end of the esophagus and the side of the duodenum below the closed end. When terminolateral anastomosis between the esophagus and jejunum is effected, a complementary entero-anastomosis should always be done between the ascending and descending limbs of the jejunal loop. If a very wide anastomosis is done, the resultant pouch functions better as a

# SURGERY GYNECOLOGY AND OBSTETRICS

Reid has severed the jejunum near the jejunal junction sutured the distal end of esophagus end-to-end and sutured the al end to the side of the jejunum a few below the esophagejejunal anastomosis of these complicated procedures which en the time of the operation seem inad e when one considers the very high operative sility at best. Many of the reported operative is occurred during the procedure after the ach was removed and before anastomosis d performed they were attributed to shock r imposed upon the poor general health of patients

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## REPAIR OF RUPTURE OF THE MALE URETHRA

WITH REPORT OF EIGHT INJURIES FROM FALLING ASTRIDE A MANHOLE COVER<sup>1</sup>

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FROM the period of January 1, 1921 to January 1, 1934 we have had under our care 31 male patients suffering from traumatic rupture of the urethra. Eight of these patients incurred this injury from falling astride a loose manhole cover (Fig. 1).

A search of the literature and a survey of the available texts on urology and traumatic surgery failed to find mention of this particular type of accident in relation to urethral trauma. Personal inquiry, however, has disclosed the fact that in the larger metropolitan areas this injury while in no wise as common as our own figures would indicate occurs sufficiently often to deserve comment.

The blow received by the perineum in these cases is especially severe because the metal cover is swung violently upward and strikes as the body is lurching downward and forward. In the 8 patients so injured the posterior bulbous urethra close to the triangular ligament received the impact. In none was the pelvis or other bones fractured. All presented the usual symptoms of injury to the anterior urethra—bleeding from the meatus, swelling and discoloration of the perineum and difficulty in voiding. Fortunately all of these patients were seen relatively soon after the injury (Table I) and in only 3 patients was there any urinary extravasation. In one of these men repeated futile attempts to pass a catheter

through the urethra before he was seen by us undoubtedly accentuated the pen urethral hemorrhage and extravasation of urine. It was interesting to note that none of these men was injured in line of duty so that the accident could not be classed as an occupational one.

When the urethral floor is so severely traumatized that continuity is destroyed the proximal (vesical) portion is retracted and elevated by the pull of the strong fascial attachments of the urogenital diaphragm. The extent of the separation of the torn urethral edges depends largely upon whether the floor of the urethra alone is severed or whether the roof also is torn across. If the floor alone is injured and the roof of the urethra is intact one may be fortunate enough to guide a small soft rubber catheter (W. Hare) passed over a fairly rigid stylet by careful and close adherence to the roof of the urethra during the insertion. When this procedure is successful bladder drainage is supplied by the indwelling catheter and unless there has been perineal extravasation or marked hemorrhage no incision is necessary. In the latter event single or multiple incisions in the perineum with adequate provision for drainage will suffice and the urethral lumen will restore itself along the indwelling catheter. This method was successful in Case 6 of our series. Except in instances of crushing injury of the floor of the urethra without separation of the urethra at the point of injury catheterization even carefully and expertly done is rarely possible. It should be emphasized that repeated unsuccessful attempts at catheterization only increase the local injury and add to the dangers of increased hemorrhage and deep seated infection.

In all patients with rupture of the urethra from external violence the ease of repair and the rapidity of recovery depend largely upon the avoidance of unsuccessful catheterization and the recognition of the necessity for immediate surgical interference. In these patients under discussion as will be seen from the accompanying table the problem was made easier by virtue of early operation. In only one instance (Case 3) was urinary extravasation an important consideration.

Until recently we favored the perineal approach in draining the bladder and in attempting properly to restore the urethral lumen. While these



Fig. 1. Man who fell astride loose manhole cover.

TABLE I

Case	Year seen	Age	Occupation	Interval before operation	Treatment	Stay in hospital
1	1923	16	School boy	14 hrs	Perineal	10 days
2	1925	34	Clerk	0 hrs	Perineal	12 days
3	1927	38	Carpenter	30 hrs	Suprapubic and perineal	23 days
4	1928	22	Salesman	12 hrs	Suprapubic	18 days
5	1928	54	Chauffeur	4 hrs	Perineal	10 days
6	1928	42	Fireman	12 hrs	Indwelling catheter	8 days
7	1930	40	Bookkeeper	12 hrs	Suprapubic	21 days
8	1930	32	Merchant	10 hrs	Suprapubic	19 days

patients did well when so treated, and usually enjoyed a somewhat shorter hospitalization than those treated suprapubically, the resultant perineal and urethral scarring was always considerable and necessitated subsequent frequent and repeated urethral dilatation over a prolonged period of time. In fact, urethral sounds must be passed several times each year to prevent the development of troublesome urethral stricture.

The method which we now prefer, and which we believe offers definite advantage over perineal urethrotomy, is extraperitoneal suprapubic cystotomy with retrograde splinting of the urethra by indwelling catheter and perineal incision only when necessary to drain extravasated blood and urine. This method is not original, having been described by George G. Davis in Chicago and by others abroad. As may be seen from the accompanying schematic drawings (Figs. 2 and 3) interlocking sounds are passed simultaneously through the posterior urethra and anterior urethra and joined in such a way that the urethrally introduced member (male sound) may be fitted snugly into the sound passed through the bladder neck (female sound), thus permitting the former to be guided safely into the bladder. If one remembers that the proximal portion of the urethra has been pulled upward and toward the bladder and realigns the urethra over the female sound by gentle pressure downward and forward as this sound is passed the interlocking procedure is easily accomplished without superimposing additional trauma at the site of rupture.

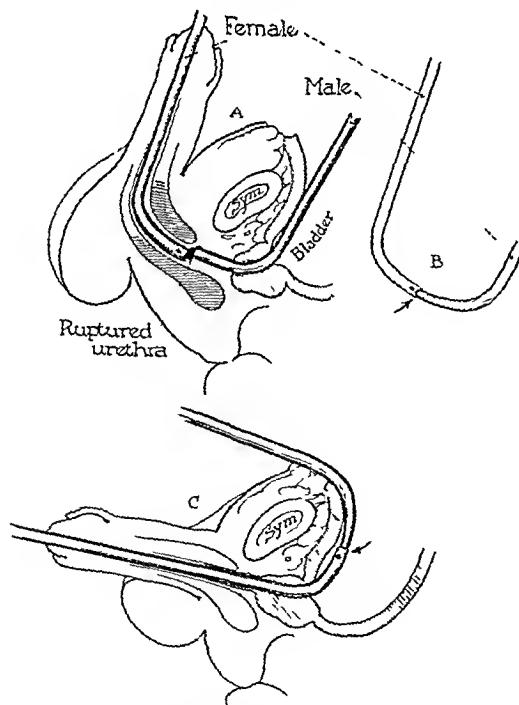


Fig. 2 A, Illustrates interlocking sounds (designed by G. G. Davis) guided through the urethra and through the vesical orifice until they are properly joined. B, Position before guiding urethral sound into bladder. C, After sound has been guided into bladder.

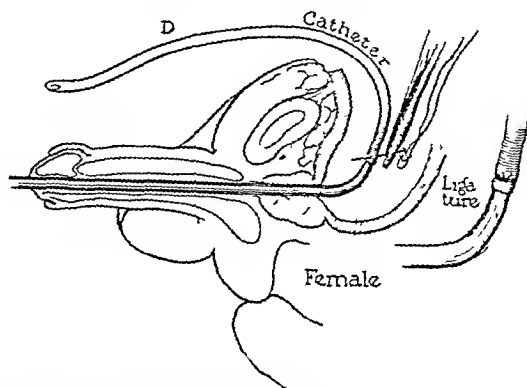


Fig. 3 Method of suturing catheter to "male" sound so that it may be drawn safely through the urethra.

A No. 22 F soft rubber catheter is then stitched securely over the end of the male sound and the edges of the catheter are tied tightly to approximate the taper of the sound closely. This facilitates the ease of drawing the catheter back through the urethra and insures a smooth passage through the friable ruptured portion. This step is an improvement over the method of Davis in which the eyelet portion of the catheter is loosely stitched to the sound with the possibility that it may pull loose or catch upon the urethral edges during withdrawal.

When the catheter has been fixed in the urethra in its proper position the bladder is closed in the usual manner with a small mushroom catheter in the dome of the bladder for immediate drainage. The urethral catheter is closed for a period of 5 to 7 days suprapubic drainage being allowed during this time. The urethral catheter is then opened the bladder is irrigated and the suprapubic tube is removed. There is rarely any suprapubic leakage of urine after this time drainage being adequately supplied through the urethral catheter. The latter is removed when the supra-

pubic wound seems firmly healed usually on the twelfth to the sixteenth day after operation.

The complete restoration of normal urinary function and the subsequent lack of urethral stricture are the obvious advantages of this method when we compare the results with those in patients previously operated upon solely through the perineum. These patients require occasional urethral dilatation to be sure but they are in no wise the serious potential stricture problem that we have almost invariably had after penile urethrotomy.

#### CONCLUSIONS

Rupture of the male urethra from falling astride a loose manhole cover offers the usual emergency problem of this type of injury from any other cause. Fracture of the pelvis or other bones was not an associated condition in the group seen. The immediate and remote results in treatment of later cases in this group as well as a number of other similar cases not included in this particular type of injury suggest the advisability of suprapubic repair as here described rather than by the more commonly employed penile procedures.



THE INJECTION TREATMENT OF HERNIA<sup>1</sup>

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IN the last few years much interest has been aroused in the possibilities of treating hernia by a non-operative method. Despite the well known fact that thousands of cases of hernia have been treated and are being treated today by a method of injection there has been very little scientifically conducted investigation to determine the value or dangers of such a method of treatment. In an attempt to evaluate this method of treatment of hernia, the authors early in 1934 decided to undertake a careful and systematic study based on experimental and clinical observation. The results of this study are herewith presented in the nature of a preliminary report, with the belief that with a better and more scientific understanding of this procedure the profession may accept this method as a welcome addition to, but not as a substitute for, the recognized surgical methods for the eradication of hernia. Although sympathetically understanding the natural prejudice of conservative surgeons who condemn the injection treatment as unsound, it has been our experience in investigating such criticism to find that it has been based on a complete lack of understanding or knowledge of the rationale of this new method.

A study of the historical development of this subject may explain the prejudice against this method of treatment. In 1832, Heaton, of Boston, first advocated its use but because he refused to divulge the exact technique to the medical profession through the American Medical Association no official recognition was given him and his method was justifiably criticized. In 1835, Velpeau claimed to have successfully treated several patients by the injection method. In the succeeding hundred years many men, mainly names connected with border line medical practice, advocated and claimed cures by different types of this treatment. Various solutions such as iodine, tincture of cantharides, extract of white oak bark, alcohol and carbolic acid were advocated by these men, and as a result there were many untoward reactions and occasional fatalities reported during the last one hundred years. Necrosis, sloughing and atrophy of the testes, severe cellulitis, fecal fistula, peritonitis, and failure to cure, together with the type of questionable medical men practicing the method in an unscientific and empirical manner aroused criticism and prejudice against

the treatment, by the profession. In the latter part of the nineteenth century the so called paraffin method of injection became very popular but the poor results brought further disfavor.

In the last few years, however, in different parts of the world, able surgeons have quietly and cautiously investigated the possibilities of a non-surgical treatment of hernia. Reports are beginning to appear in the English and European literature, as well as in the American literature, of the successful treatment of thousands of cases with good follow-ups and without any untoward results of the treatment of hernia by a method of injection.

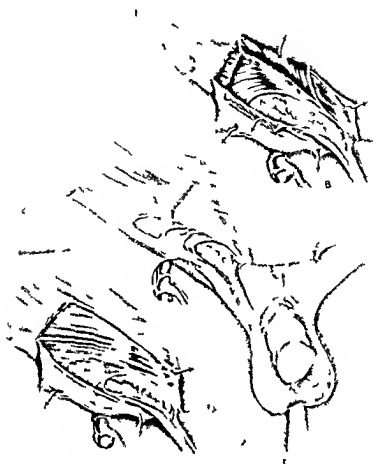
In order to understand properly the rationale of such a method of treatment, one must for the moment briefly review the mechanism of the ordinary inguinal hernia.

## MECHANISM OF INGUINAL HERNIA

Assuming the existence of a congenital or pre-formed sac, if the hernia is to become clinically apparent it is necessary that the contents of the sac descend to a position where the patient objectively or subjectively is conscious of its existence. By reference to Figures 1 and 2 it is apparent that for the rupture to appear clinically in either the indirect or direct type the external oblique muscle must be sufficiently separated from the internal oblique and the transversalis fascia to form a patent inguinal canal which permits its descent. If by any mechanical means the separation of these muscles is prevented, the hernia cannot descend. It is well known that if a person who has a rupture holds himself over the inguinal region when he coughs or sneezes the hernia does not descend. The wearing of a satisfactory truss likewise prevents the descent of the hernia by exerting pressure directly over the inguinal canal, thus preventing the external oblique from becoming separated from the underlying muscles. If the external oblique is compressed tightly upon the underlying internal oblique and transversalis fascia the potential space in the inguinal canal is obliterated and the contents of the sac cannot descend.

If then by any means we can prevent the external oblique from separating from the subjacent muscles the hernia will never descend despite the existence of a sac. This is exactly the result at-

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tained by the injection into this region of a solution which produces fibrin. Such fibrin is proliferates the patency of the inguinal canal by producing an intimate adherence of the muscle layers in this region in a manner almost identical to that accomplished by the suturing of the surgical procedure.

## TECHNIQUE FOR THE INJECTION

The proper method of injection treatment in cases at this point is a discussion of the essential element which leads to a successful and safe cut

come namely the selection of a suitable solution for the injection. The various solutions used in the past and which have proved unsatisfactory were those which produced a severe form of inflammation in the inguinal canal by introducing into this region strong chemical irritants. As the inflammation subsided a fibrous tissue formed which bound together the muscles constituting the inguinal canal and by dense scar tissue proliferated it. An inflammatory reaction sufficient to produce this result however carries with it a danger of untoward systemic reaction, an allergic

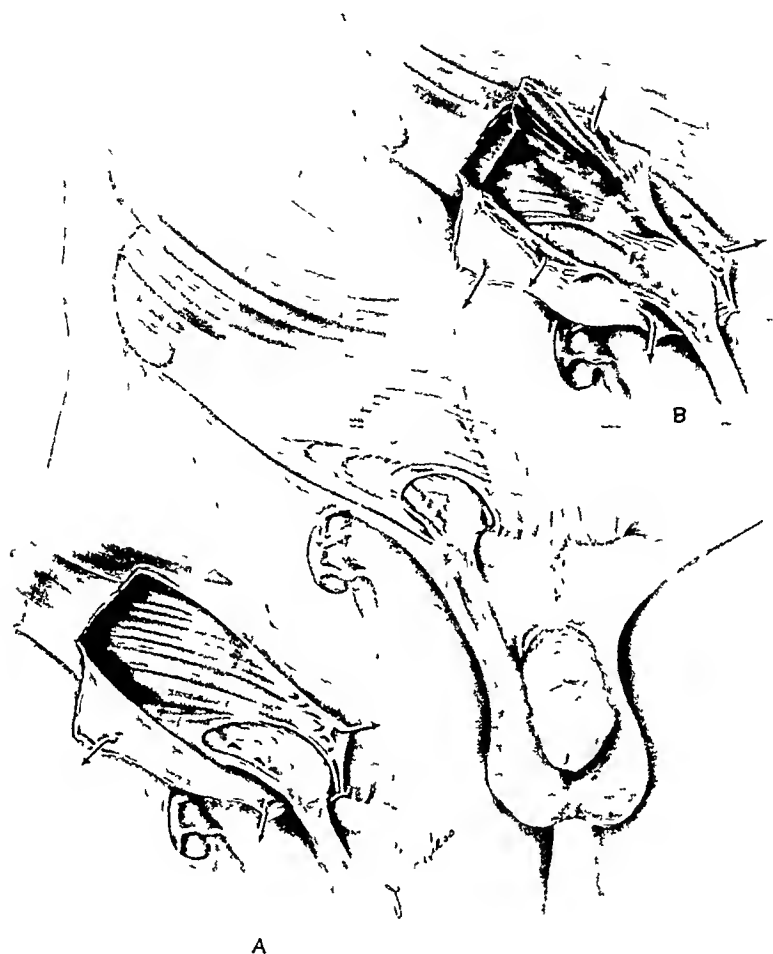


Fig 2 Surgical anatomy of the direct type of inguinal hernia, showing the emergence of the sac from the external ring. Inset A shows the external oblique reflected, indicating emergence of the hernial sac beneath the conjoint tendon. Inset B shows both the external and internal oblique reflected, with the sac emerging through the transversalis fascia in the region of Hesselbach's triangle.

sloughs. Furthermore, such scar tissue as is formed by such methods yields more readily to normal tissue absorption so that the permanency of the obliteration of the inguinal canal is questionable. The solutions used in the past based on such a principle were strong caustics such as phenol, iodine, and others mentioned.

The principle underlying the more modern solutions is entirely different. The solutions are relatively non-irritating and do not produce a severe inflammatory reaction and they appear to be non-injurious to tissue. They produce no

systemic reaction from their absorption and are relatively non-toxic if mistakenly injected intravenously. Furthermore, they produce no peritoneal inflammation if through errors in technique they are injected into the peritoneal cavity. By experimental work and clinical results the modern solutions have proved to produce a predominance of the proliferative phase of the inflammation resulting in fibroblastic formation with the minimum of the exudative stage.

The basis of the majority of modern solutions is tannic acid extracted from certain vegetable barks



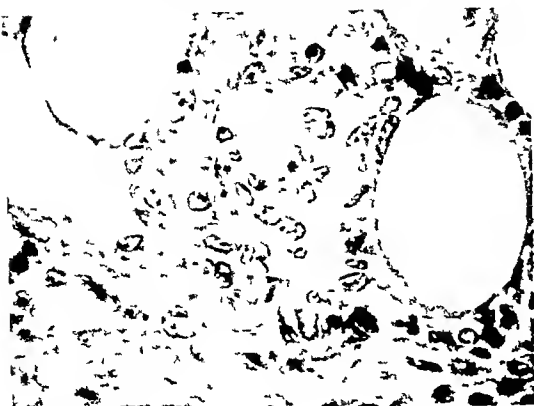


Fig 5 (571-B-3) Two tenths cubic centimeter of the solution was injected as outlined in the text and sections were taken after a 6 day period. The inflammatory reaction is limited to the connective tissue septa and fat between the muscle bundles, with no destruction of the muscle fibers. A group of large undifferentiated mononuclear cells is shown replacing fat and connective tissue. The polymorphonuclear neutrophils have disappeared, a few lymphocytes and plasma cells are present. These undifferentiated cells ultimately become fibroblasts.

in the proliferating fibrous tissue. The fibrous tissue is very edematous at first with rare collagen fibrils between the star-shaped cells. As the lesion progresses it tends to form whorls and bands composed of the typical spindle-shaped fibroblasts which are separated by well formed collagen



Fig 7 (614-B-3) Two tenths cubic centimeter of the solution was injected on alternate days for eight injections, total amount injected, 1.6 cubic centimeters. Sections were taken 26 days from first and 8 days from last injection. The fibrous tissue is more compact due to the increase in collagen, and often extends between muscle fibers. A group of small vessels and nerves is surrounded by the proliferating fibrous tissue. Undifferentiated mononuclear cells around small vascular channels and phagocytic mononuclear cells holding hemosiderin are present.



Fig 6 (574-V) Two tenths cubic centimeter of the solution was injected on alternate days for six injections. The total amount of solution injected was 1.2 cubic centimeters. Sections were taken 19 days from the first injection and 6 days from the last injection. There is a proliferation of edematous fibrous tissue separating and replacing slightly distorted muscle fibers. This fibrous tissue is present as large whorl like masses and special stains reveal prominent collagenous fibrils. In this fibrous tissue are a few scattered mononuclear cells and lymphocytes. The muscle fibers in the zone of reaction are irregular in shape and have lost the transverse striations.

Polymorphonuclear leucocytes are not encountered in the inflammatory reaction after 24 hours, but lymphocytes and plasma cells are usually noted. Hemosiderin increases in quantity as the lesion grows older. In the early lesions there is marked dilatation and engorgement of the cap-



Fig 8 (859-L-1) Two-tenths cubic centimeter of the solution was injected on alternate days for ten injections in all. The total amount of solution injected was 2.0 cubic centimeters. Sections were taken 75 days from the first injection and 55 days from the last injection. The fibrous tissue is now represented by compact bands which are separated by a slightly edematous tissue in which may be found foci of phagocytic and mononuclear cells. Two bundles of nerves surrounded by the dense fibrous tissue can be noted.

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illaries. The main mass of proliferating fibrous tissue is usually in the connective tissue septa and fat adjacent to the large muscle bundle. Nerves are moderately replaced by this fibrous tissue and are frequently surrounded by this fibrous tissue.

To summarize the agent provokes an immediate polymorphonuclear leucocytic response of short duration followed by a gradually increasing reaction from the mononuclear mesenchymal elements which differentiate into spindle cell fibroblasts resulting in marked desmoplasia.

An attempt was also made to determine the reaction of the injected solution when placed within the peritoneal cavity. Guinea pigs were injected with varying amounts of solution in dosage relatively much greater than those which would ever be used in a human subject. Normal guinea pigs were injected with  $\frac{1}{4}$ , 1 and 3 cubic centimeters of the solution intraperitoneally and examinations made 6, 24 and 72 hours following the injection. Macroscopically examination of the animals was entirely negative. Sections of the bowel, liver, spleen, lymph nodes and parietal peritoneum were entirely negative except for a very slight swelling of the mesothelial cells lining the peritoneum. These experimental findings are similar to those reported by Rice.

Theoretically then if one is able to produce a proliferation of new fibroblastic tissue into the inguinal canal by the injection of non-injurious solutions such tissue can be so placed as to obliterate the inguinal canal. To prevent destruction of this newly formed connective tissue by frequent distention of the canal brought about by frequent descent of the sac contents it is essential during the process of active treatment that constant external pressure be maintained over the muscles of the inguinal region. This can be easily accomplished by the use of a satisfactory truss. Such a truss must keep the sac contents completely and constantly reduced during the entire active period of treatment in order to give the newly formed connective tissue in the region of the inguinal canal time to organize firmly and strongly.

The scientific basis for the treatment of hernia depends then on a proper understanding of the mechanism of producing a non-toxic non-injurious solution (1) the necessity of external pressure produced by a truss to prevent the descent of the sac contents while surgery is being carried out (2) the necessity of maintaining the inguinal canal in a state of constant contraction during the entire active period of treatment.

The injection treatment of hernia is possible in patients of all ages but with the present extent of

the knowledge of this subject it is advisable to limit its use to adults. The prime requisite is that the patient has a completely reducible hernia at all times during the course of active treatment.

Cases of direct and indirect inguinal and femoral and incisional hernias have been successfully treated by this method at the best at the present time to limit its use to the inguinal varieties. Chronic bronchitis and cardiac disease are no contra-indication for the injection treatment.

## TECHNIQUE

The first and most important consideration in the actual treatment of any given case is the application of a truss. The hernia must not only be reducible but it must be one which can be held completely reduced at all times regardless of the activity of the patient. The actual type of truss is unimportant as long as it fulfills this fundamental rule. The truss must be worn day and night during the course of injection and for a 4 week period thereafter. Depending on the physical activity of the patient it must further be worn during the day for an additional 4 to 6 months. It is therefore imperative that as the patient keeps it on during his bath. The type of truss found most satisfactory is a cum rigid frame truss with a low posterior fulcrum. The elastic type of truss has not proved satisfactory and is not advised. When the patient is tired with a proper truss for him he is instructed to wear it day and night for a period of 1 week and if it is uncomfortable or if the hernia is not held completely reduced adjustments are made as necessary. Occasionally in patients who have never worn a truss before there is considerable irritation of the skin and it may be necessary to discontinue wearing it for a few days. Before beginning the treatment however every difficulty involved in the fitting and wearing must be adjusted. This may take from 1 to 3 weeks but when time is well spent as it assures the success of the subsequent treatment. Once the treatment is begun the truss is never removed except by the physician for the purpose of treatment.

The treatment is begun with the patient lying on a surgical table in the kneeled position and the truss is removed by the physician. It has been found unnecessary to remove the truss entirely as

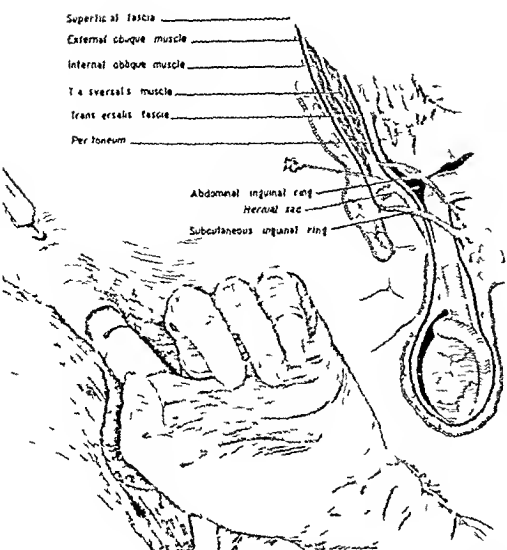


Fig 9 Diagram to show the method of invaginating the scrotum with the index finger of the left hand. The Luer syringe and needle is shown injected beneath the external oblique. The diagrammatic cross section shows how the tip of the needle can be palpated when in proper position by the invaginating finger.

it can be slipped down over the thighs while the patient aids by slightly lifting the buttocks. With the truss removed and the patient in this position, the hernia is found to be completely reduced. The inguinal region is shaved and cleansed with alcohol, then painted with iodine solution or tincture of merthiolate, after which the patient is ready for the injection of the proliferating solution. Our purpose as explained is to inject the solution into the inguinal canal, below the external oblique muscle, but not into the sac of the hernia. A suitable local anesthetic is given preliminary to the injection of the solution. A local anesthetic of novocain 2 per cent is satisfactory, but a combination of novocain 2 per cent, nupercaine 1:1000 and benzyl alcohol 2 per cent in distilled water gives a more prolonged effect.

The choice of a needle depends on the distance between the skin and the inguinal canal. This varies with individual patients and with the thickness of the abdominal wall. In thin persons a needle 1 to 1½ inches is satisfactory, while in more obese patients needles of 1½ to 2½ inches may be required. Generally speaking, the smallest gauge which is commensurate with the length is the most satisfactory one to use. With the proper size needle determined it is fitted to a 5 cubic centimeter Luer syringe and it is filled with the anesthetic.



Fig 10 Photograph of actual technique. Note that the patient is in Trendelenburg position with the hernia completely reduced. The truss is drawn downward over the thighs. The tip of the index finger of the examining hand is shown invaginating the scrotum, while the syringe, loaded with local anesthetic, is held preparatory to injection of the needle. Note that the needle is held at an angle of 45 degrees to the abdomen with the point directed away from the peritoneum.

The syringe is loaded with 4 cubic centimeters of the local anesthetic and the injection is given with the operator standing on the left side of the patient. Regardless of whether the hernia is on the right or left side, this position is most satisfactory for right handed operators. The index finger of the left hand is then placed into the external ring by invaginating the scrotum (see Figs 9 and 10). The tip of the invaginating finger can be palpated by the right hand. A spot approximately ½ centimeter above this area is selected and the needle with the Luer syringe attached is inserted through the skin, fat, and through the external oblique muscle. No skin bleb of anesthetic is used since the injection of the needle through the skin is no more painful than the injection of the bleb. As the needle passes through the external oblique there is a definite "give" similar to the one experienced in passing a needle into the spinal canal. This will be more marked if the needle used has a blunt bevel. The needle within the inguinal canal can be readily palpated by the index finger of the left hand which is invaginated through the scrotum into the canal. The plunger of the Luer is then withdrawn slightly to make sure that a blood vessel has not been entered, and if no blood is withdrawn the anesthetic is slowly injected. Following the injection, the Luer is removed from the needle but the needle is left in place. This is done so that the anesthetized area will correspond exactly to the area which will be injected shortly by the proliferating solution. If the needle is removed and a second needle injected with the solution after the anesthetic has taken effect, it is difficult to get the

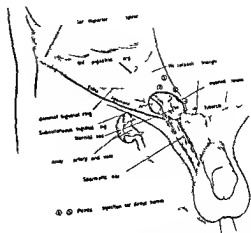
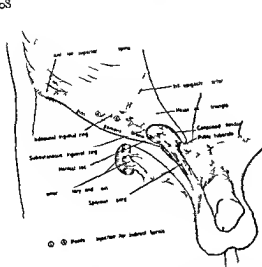


Fig. 12. A diagrammatic representation of the points of injection for direct and indirect hernia. The diagram indicates the anatomical structures involved in the hernia, including the inguinal canal, spermatic cord, and various ligaments. The points of injection are marked with numbers 1, 2, and 3, corresponding to the legend below.

Fig. 12. A diagrammatic representation of the points of injection for direct and indirect hernia. The diagram indicates the anatomical structures involved in the hernia, including the inguinal canal, spermatic cord, and various ligaments. The points of injection are marked with numbers 1, 2, and 3, corresponding to the legend below.

exact layer of anesthetized tissue. The projecting hub of the needle is then covered with a sterile gauze pad and the patient is cautioned neither to move nor to cough.

A 10 minute period is then allowed to elapse in order to give time for the focal anesthetic to take effect. The Luer syringe is then filled with 3 cubic centimeters of the proliferating solution and attached to the needle and the solution is slowly injected. The needle is removed and the patient is allowed to remain in the Trendelenburg position for a period of 10 minutes following which the truss is reapplied by the physician and the patient can get up from the table.

Subsequent injections are given every other day and all except the first injection are of 4 cubic centimeters of the proliferating solution. In all injections following the initial one the amount of anesthetic used is 5 cubic centimeter. In other words the amount of local anesthetic used should be 1 cubic centimeter greater than the amount of proliferating solution injected.

The location of the main sites of subsequent injections is diagrammatically shown in Figures 11 and 12. At each of these points one to three injections are given depending on the seroplastic reaction of the individual to the solution. It will

be noted that in this technique injections are started at the region of the external ring and in an indirect hernia injections are placed laterally to 1 centimeter apart along the canal until the region of the internal ring is reached.

Consideration was given to the possibility of starting injections at the internal ring and placing subsequent ones down the canal toward the external ring. Such a technique carries with it a greater danger of incarceration. Before the internal ring can be obliterated completely a tongue like projection of the sac contents might theoretically become involved in the exudate producing strangulation. When injections are started at the external ring the exudate acts like an internally placed truss forcing the sac contents ahead of it back into the peritoneal cavity and lessening such danger. Furthermore the internal ring areas considerably in its location due to distortion depending on the size of the hernial mass whereas the external ring is more constant and usually more easily located.

After a few injections it is hard to identify the external ring and a rubber hard like mass is felt occupying the lower part of the inguinal canal. If injections are now continued into this area the needle feels as if it is being inserted into rubber.



After a few injections one sometimes notices on aspirating following the injection of the preliminary novocain, the return of a yellowish, murky fluid. This should not be mistaken for either bladder contents or peritoneal fluid. It represents the mixture of the anesthetic agent with the edematous exudate in the inguinal canal and injections may be continued into such a region. If the hernia is of the direct type injections are given in the region of Hesselbach's triangle. Injections are given until the inguinal canal and the region of Hesselbach's triangle are entirely closed.

The treatment of umbilical, ventral, and femoral hernias will be described in detail in a subsequent paper, if future experience justifies its use in these cases. The principle involved is similar. In these types the proliferating solution is injected into the fascial and muscle layers immediately surrounding the defect.

The number of injections in any given case depends on two factors, the size of the hernia and the seroplastic reaction of the individual. As a general rule the older the patient, the smaller the seroplastic reaction, in other words, the older the patient, the more injections. In young adults the number of injections have been as low as seven, while in elderly people, especially those with large hernias, as high as thirty-four have been given.

After the last injection the patient continues to wear the truss day and night for a period of 4 weeks to allow the newly formed fibroblastic tissue to increase in strength. At this stage of the treatment, any descent of the contents of the sac would cause distention of the inguinal canal and a tearing and destruction of the newly formed fibroblastic tissue. Following this 4 week period, it is advisable to wear the truss during the day only for an additional period of 4 to 6 months.

Complications during the course of treatment are surprisingly small. Patients not infrequently complain of curious transient subjective sensations such as burning in the scrotum or penis, on the inner side of the thigh, or a sensation of warmth around the anus. These painful sensations are due to involvement of the ilioinguinal nerve and its branches. By slight movement of the injecting needle, when such sensations appear, this type of pain may be minimized. Occasionally a few seconds after an injection in the neighborhood of the internal ring, there may be a feeling of cramp in the distribution of the anterior crural nerve. Following the first or second injection there may be some swelling and induration of the inguinal canal or of the cord, the skin of the scrotum or the epididymis. This may be painful but

it has never kept a patient from his routine duty and quickly responds to local applications of heat. Such complication is due to temporary obstruction of the spermatic circulation from the edematous reaction produced by the solution. However, there has been no case of permanent damage or any atrophy of the testicle. If, while giving an injection, the needle inadvertently enters a blood vessel, it is withdrawn and no injection is given that day. This has occurred about once in every seventy-five injections in our series. Rarely the needle is injected into the peritoneal cavity, and in our series it has occurred only three times in about a thousand injections. If the proliferating solution is injected into the peritoneum, the patient complains of extremely severe cramp-like pain which gradually subsides in 10 to 20 minutes, depending on the amount of solution injected. No untoward results have been seen clinically, nor have they appeared as herein outlined experimentally from this accident. In order to minimize these accidents the injection of the proliferating solution should be given *very slowly* and at the first complaint of colic-like pain, the injection is discontinued.

#### CONTRA-INDICATIONS AND DANGERS

No case of irreducible, incarcerated, strangulated or sliding hernia or hernia associated with undescended testicle can be considered suitable for treatment by this method. The danger of perforating the bowel in such cases with a production of fecal fistulas and peritonitis is obvious. Even in the reducible hernias the peritoneal cavity may be occasionally entered through an error in technique, and although there is no danger to life by such a mistake the patient experiences pain sufficient to produce a state of shock. To minimize such a dangerous complication, emphasis cannot be placed too strongly on the necessity of injecting the proliferating solution slowly and cautiously.

Hemophilia is a contra-indication to this procedure as it is for any treatment which requires repeated punctures with a needle. Chronic urinary retention in elderly men increases the danger of bladder injury, and unless one is thoroughly experienced such cases should not be attempted.

It is a general surgical principle that injections of any type should not be given in the face of apparent superficial skin infection, and the indiscriminate use of this method of treatment in patients suffering from any type of infection in the area to be injected must result in disaster. Diabetics are best not treated because of their increased susceptibility to local infection.

TABLE I

Type of business	%	Time employed	Average production	Unit cost
Indirect industrial		3		0
Direct industrial	35	6		3
Indirect recreational			9	
Direct recreational	3	3	0	
Domestic			7	
Commercial			4	
Unemployed	3			
%	100	67		33

Cases in which the intelligent co-operation of the patient cannot be absolutely assured are best advised against this treatment. The inconvenience of wearing a truss continuously day and night for a period of 6 weeks to 2 months should be thoroughly explained to the patient and unless a promise of obedience to this rule is obtained there is danger of complete failure of the treatment. A partially completed treatment in such a case may increase the danger of strangulation in that particular hernia. Highly nervous or apprehensive individuals, patients with hyperthyroidism and children are not good subjects in general for any form of local injection treatment and are better treated by the recognized surgical procedures.

Especially dangerous is the use of solutions which have not been proved by experimental and clinical results to be suitable for the treatment of hermia by injection. The type of solution used in the treatment of arcoses is absolutely contra indicated as it works on an entirely different principle.

## RESULTS

Since this work was started in the Out Patient Department of the Mount Zion Hospital early in 1934 100 cases have been treated by the authors. The entire number of injections have been well over one thousand and Tables I and II summarize our results. Although it is too early to state definitely that the results are equal or even better than those treated by surgery we can say that at the completion of treatment in all these cases and in the short follow up period available up to this date October 1935 the results from both the patients and the surgeons standpoint have been eminently satisfactory. We have had no case in which the hernia has not been completely obliterated subjectively and objectively. Bratrud, Mayer and Fowler in this country and Gray in England. Pina Mestre in

TABLE II -- FOLLOW UP RECORD

Length of new removal of rose	Months
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12

Tul

Tal Barcelona Spain have reported many hundreds of cases with longer follow ups and their results have been entirely satisfactory. These authors claim a recurrence of from less than 1 per cent to 4 per cent.

A redefinition of the word recurrence must be found as we apply it to a discussion of cases treated by the injection method. If a weakness appears at the site of the hernia following treatment by the injection method we can more properly say that this case is one in which there has been insufficient treatment. If such a weakness does occur a few additional injections will close the hernia. It is not a recurrence in the surgical sense of the word but rather insufficient treatment. If we find for example that those patients who have had six or eight injections show weakness in the course of a few months following treatment it may be necessary to increase the number of initial injections to ten, twelve or even fifteen as a routine procedure. If despite an indefinite number of injections the weakness still persists these cases are the ones that we can classify as recurrences.

### ADVANTAGES

**ADVANTAGES**

There is no mortality attributable to the injection method as used today. Reports of mortality appearing in the literature from 1840 to 1910 followed the injection of phenol iodine etc. and do not in any sense apply to the modern method. The dangers of postoperative pneumonia embolus and the other complications following the surgical treatment of hernia are familiar to all of us. It is significant that not once in the modern literature does there appear a record of similar complications following the injection method. The injection procedure can be used on many occasions for various reasons are demonstrated in the following cases.

It is significant that the literature does there appear complications following the injection. The injection procedure can be used on many patients who for various reasons are denied surgical treatment. Cases of so called poor operative risks whether due to heart disease advanced age diseases of the lungs etc are being successfully treated by this method. Many ambulatory hernias untreated for years are being cured by this method. One million cases of because

The treatment is entirely ambulatory. Many of the estimated six million hernias untreated in this country today are not taken care of because

the patients are unable to leave their work for the necessary 6 to 10 weeks involved in the surgical treatment. The advantage of the lessened cost due to elimination of hospitalization and loss of work is obvious.

The method is particularly valuable in cases of recurrent hernia. Such cases are the bane of the surgeon. An operator should welcome a method which offers the possibilities of successfully treating recurrent hernias without recourse to surgical intervention. The results obtained by the injection treatment in this group of cases have been in our experience particularly gratifying.

#### SUMMARY AND CONCLUSIONS

This method is advocated as a valuable adjunct to the surgical armamentarium. The use of this treatment requires accurate knowledge of the anatomy of hernia, skillful handling of the technical procedure, and the ability to fit trusses properly. It is a method that should be used only by surgeons who have had actual experience in surgery of the parts involved. Even such men should learn the method by contact with centers where this treatment is being used. The indiscriminate use of this method without these requisites will give unsatisfactory results.

1 The basis for the injection treatment of hernia appears rational and scientific if the mechanics of hernia are carefully studied.

2 Modern solutions used for the injection treatment are based on the principle of producing new fibroblastic tissue without local injury or danger from toxic absorption. Experimental and clinical findings are described to substantiate these claims.

3 This method of treatment is applicable to all patients with hernia that are completely reducible who can be fitted with a truss which will maintain complete reduction during active treatment.

4 This preliminary report is based on the study of one hundred consecutive cases treated in the Out Patient Department of the Mount Zion Hospital successfully without any serious complications.

5 The evidence submitted, although in the nature of a preliminary report, should suffice to convince the profession that this method of treatment is worthy of a thorough and impartial investigation.

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# PROPHYLAXIS IN GYNECOLOGY

WITH SPECIAL REFERENCE TO THE IMMEDIATE CARE OF THE POSTPARTUM CERVIX

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IT is an established fact that the cervix of every parturient woman is lacerated in some degree during either an artificial or spontaneous first stage of labor. Such injuries vary from insignificant breaks in the cervical mucosa to extensive lacerations which involve the entire cervical musculature. It is equally true that superficial lacerations though they as well as the deeper ones may predispose to cervical infection in the early days of the puerperium as has been shown by Goodall and Weissman usually heal spontaneously and leave little or no anatomical or pathological change in the completely involuted cervix. On the contrary the more extensive lacerations in a large majority of cases fail to heal spontaneously and therefore predispose through the exposure of the endocervix to the bacterial flora of the vagina to chronic cervicitis with its well known sequelae. It is with this latter group of lacerations that the present study primarily deals and though the conclusions drawn from it are by no means decisive it is hoped that it may stimulate interest in a neglected gynecological procedure namely primary trachelorrhaphy as a prophylactic measure against chronic cervical infections.

Cervical lacerations were first described by Sir James Simpson (1851) who pointed out the facts that they were of frequent occurrence that they were unavoidable in labor and that they were of various degrees. Similarly in 1861 Robert Ellis of London redescribed the lacerated eroded cervix consequent upon delivery. But the credit for first having performed immediate trachelorrhaphy belongs to Montrose A. Pallen who published an account of two successful cases in 1874. The indication in these cases was hemorrhage. Ten years later in 1884 Karl Schroeder recommended drawing and crowding the uterus down to the vulva for in punction and if necessary for operation directly after labor. Among the more recent advocates of immediate cervical repair must be numbered E. P. Davis DeLee Emge Skeel and Bubis. Others both in this country and abroad have published valuable articles on the subject all of which show that significant cervical lacerations are detectable immediately after the third stage of labor that immediate trachelorrhaphy is successful in approximately 80 per cent of cases

and that the fear of puerperal sepsis which has deterred many obstetricians from attempting the procedure is based on theory rather than on facts.

The objects of the present study which was begun in February 1906 have been (1) to learn the relative importance of the more common predisposing factors in the etiology of cervical lacerations (2) to determine the incidence of immediate postpartum hemorrhage from cervical lacerations and (3) to evaluate immediate trachelorrhaphy as a prophylactic procedure against chronic cervicitis.

The material which has been analyzed consists of 324 private patients all of whom the author has had under personal observation in all of their pregnancies labors puerperia and through a follow up study which has ranged over a period of from 1 to 8 years 102 of the cases have been delivered a second time and 4 cases a third time. The total number of labors therefore has been 430 while the total number of babies born has been 433. Excluding a small number of patients who have been delivered by cesarean section the cases have been consecutive and with the exception of 2 cases all have been delivered in the private obstetric service at the Woman's Hospital in the State of New York.

*Antepartum examination of the cervix.* At the tenth week of pregnancy the cervix of every case under observation has been carefully examined and all abnormalities have been recorded. In 324 primiparae the cervixes showed antepartum erosion in 9.8 per cent of the cases and infection in 3.3 per cent. In 106 multiparae the incidence of antepartum erosion was 28.3 per cent while the infection incidence was 5.6 per cent.

*Postpartum examination of the cervix.* Immediately after the third stage of labor the cervix of each case in the series has been inspected by the following technique. Immediately after the second stage of labor each patient has been given an intramuscular injection of obstetric pituitary extract (15 minims). Any manipulation of the uterine body has been avoided during the separation of the placenta unless excessive bleeding has occurred. The separated placenta membranes and cord have been expressed by the method of Crede. Immediately after the third stage of labor an intramuscular injection of ergotone (15 min

mis) has been given, and the body of the uterus has been kept in tonic contraction by massage during the examination of the cervix and the trachelorrhaphy.

Before an attempt is made to expose the cervix the introitus is opened by a Gelpi pelvic retractor. The left hand of the operator is then completely inserted into the vagina with the palm surface directed upward. With the hand so placed downward pressure on the pelvic floor facilitates the exposure of the cervix, the interior lip of which is seized in the sagittal plane of the body by a sponge forceps. A similar forceps is then placed on the posterior lip and the cervix is drawn to the introitus (Fig. 1). If the sponge forceps are allowed to remain at the mid points of the cervical lips, it is impossible to identify lateral lacerations because of the laxity of the tissues in the fully dilated cervix. By moving the forceps to a lateral position is shown in Figure 2 the identification of even the lesser lacerations is made easy. A Deaver lateral retractor placed in the vagina by an assistant on the side which is to be examined facilitates the examination. The right side of the cervix is inspected first. The forceps are then moved to the left side of the cervix and the inspection is completed.

*Appearance of the normal postpartum cervix.* Many obstetricians believe that the normal postpartum cervix, if examined immediately after the third stage of labor, will invariably be found in an edematous and distorted condition which will make impossible the identification of injuries. A considerable experience with routine examinations of the postpartum cervix will promptly establish the fallacy of such an opinion. Such edema and distortion of the cervix is found only in cases subjected to a prolonged first or second stage of labor. If, on the contrary, a patient has been delivered with reasonable promptness, the cervix is usually remarkably thin about the external os and usually has a sharp margin. On sagittal section it is decidedly wedge-shaped. The sides of the normal postpartum cervix are unequal in length, the right side being approximately 2 centimeters longer than the left. This irregularity in length appears to be invariable or almost so, and may be explained by the right axial torsion of the uterine body in labor. The sides of the cervix vary considerably in length in different patients. With the external os drawn gently to the introitus the right side is from 5 to 8 centimeters in length, while the left side is from 3 to 6 centimeters. It is extremely important to keep in mind the normal difference in length of sides of cervix when attempting to evaluate the extent of cervical lacerations.

TABLE I—TYPES OF CERVICAL LACERATIONS

	Primipara 124		Multipara 109	
	Left side	Right side	Left side	Right side
	Cases	Per cent	Cases	Per cent
Lacerations less than 1.5 cm.	57	46	33	30
Lacerations more than 1.5 cm.	54	44	76	70
Total	111	90	109	100
Lacerations less than 1.5 cm.	10	9	0	0
Lacerations more than 1.5 cm.	11	10	76	70
Total	21	19	76	70

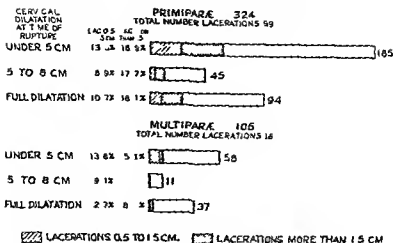
*Types of cervical lacerations.* DeLee (5) has described three types of cervical laceration: (1) lateral lacerations which involve both the mucosa and muscularis of the cervix, (2) submucous lacerations in which the muscularis only is involved, and (3) lacerations which result in an ectropion of the lacerated cervical lips. DeLee describes the mechanism of this type of injury as follows: "The mechanism of the tear is complicated and hard to understand, but I believe it is as follows. The cervix is dilated radially to the utmost and the damage to the tissues is general, that is, all fibers are stretched beyond their limit of endurance. The internal mucosa of the cervix becomes edematous and is ripped off its base, prolapsing through the external os. The appearance of such a cervix after delivery is not unlike that of the everted anus of a horse."

When examination was made of the cervixes of the patients under consideration DeLee's classification was kept clearly in mind, but in no instance did the examiner recognize any type of laceration other than a lateral one which involved both mucosa and muscularis, and in the follow-up examinations only such lacerations could be accounted for.

Table I shows the incidence and location of all lacerations in the series.

It will be noted throughout the study that cervixes have been termed "intact" when the breaks in the tissues have been less than 0.5 centimeter in extent. All other lacerations have been divided into two classes: (1) those of 0.5 to 1.5 centimeters, and (2) those of more than 1.5 centimeters in extent.

An analysis of Table I reveals the following facts: (1) the incidence of cervical lacerations is higher in primipara than in multipara, (2) the



IMPRESSION PREMATURE RUPTURE OF MEMBRANES DOES NOT PREDISPOSE  
TO CERVICAL LACERATION

Table II. I mature rupture of the membranes as a trigger of the calicogenesis

left side of the cervix is lacerated more frequently than the right side in primiparae while in multiparae the right side is involved more frequently than the left side (3) in primiparae the incidence of deep lacerations is higher than that of the less extensive one while the opposite is true in multiparae.

**Etiology of cervical lacerations** The causes of cervical lacerations may be divided into (1) predisposing causes and (2) immediate causes.

Among the predisposing causes are (1) congenital hypoplasia of the cervix (2) congenital malformations of the cervix (3) rigidity of the cervix (4) disease of the cervix (5) previous operations on the cervix (6) premature rupture of the membranes (7) abnormal first stage of labor (too brief too long) (8) presentation and position of child (9) size of child

The immediate causes are (1) excessive forces of labor (2) artificial dilatation (3) attempts at delivery through an undilated cervix (4) improper use of obstetric instruments (5) injudicious use of oxytotic drugs or extracts such as p. tuitary extract.

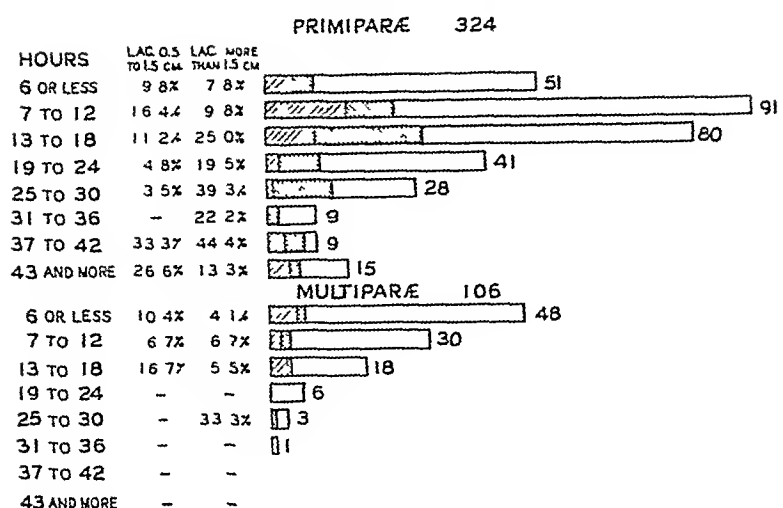
*Predisposing causes of cervical lacerations* Because of the absence of any example of the first five causes enumerated it has been impossible to study all of the predisposing causes of cervical lacerations. The influence that the following factors may have had upon the condition has been considered.

Premature rupture of the membranes as an etiological factor in cervical lacerations. Theoretically

the incidence of cervical injury should be lower when the membranes remain intact until the cervix is fully dilated. An examination of Table II which gives the incidence of cervical lacerations with both early and late rupture of the membranes shows that premature rupture does not predispose to laceration of the cervix either in primiparae or multiparae.

*Duration of the first stage of labor and the occurrence of cervical lacerations.* It is logical to believe that cervical laceration should occur less frequently when the cervix has been dilated slowly. Table III shows that the duration of the first stage of labor in primiparae has had little influence on the incidence of lacerations of 0.5 to 2.5 centimeters in depth up to a first stage of 36 hours. A first stage of more than 36 hours seems to have increased the incidence of these lesser injuries in a small number of cases. The deeper lacerations show a marked increase in their incidence when the first stage has exceeded 12 hours. The number of multiparae in whom cervical lacerations occurred is too small to warrant any conclusions.

Presenation and position of the child as a predisposing factor in the etiology of cervical laceration. Table IV shows that the left side of the cervix in both primiparae and multiparae is lacerated more frequently than the right side regardless of the presentation and position of the presenting part. There is but one exception and that is in the cases of right occipitoposterior position in primiparae in whom the right side of the cervix was injured almost twice as frequently as the left side.





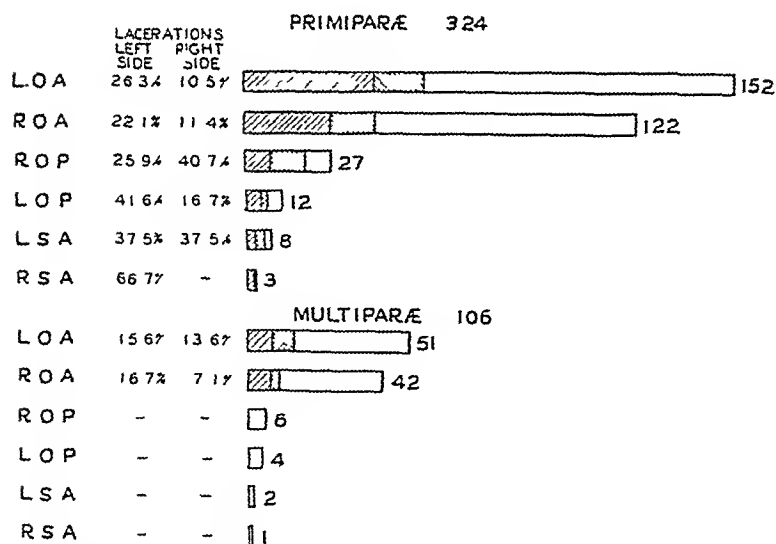
 LACERATIONS 0.5 TO 1.5 CM    
  LACERATIONS MORE THAN 1.5 CM  
 IMPRESSION A 1ST STAGE OF MORE THAN 12 HOURS PREDISPOSES TO CERVICAL LACERATION

Table III Duration of first stage as an etiological factor in cervical laceration





 LACERATIONS, LEFT SIDE    
  LACERATIONS, RIGHT SIDE

Table IV Presentation and position as etiological factors in cervical laceration

TABLE V—WEIGHT OF BABY AS AN ETIOLOGICAL FACTOR IN CERVICAL LACERATIONS

Weight of baby	Deliveries		Lacerations		Lacerations	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Under 5 pounds						
5 to 6 pounds	3	5.3	3	7	3	
6 to 7 pounds	6	7	4	3		8
7 to 8 pounds	10		7		5	9.4
8 to 9 pounds	7	8			5	4
9 to 10 pounds					6	7
Improper cervical lacerations	The larger the baby the greater the percentage of deeper					

Weight of the baby as a predisposing etiological factor in cervical lacerations. It is reasonable to expect greater damage to the cervix when the parturient has been larger rather than small. Table V shows that the weight of the baby has had little influence in the etiology of injuries up to 15 centimeters in extent. On the contrary, the incidence of the deeper lacerations has increased as the weight of the baby has increased.

Immediate causes of cervical lacerations. In view of the fact that all of the cases under consideration were private patients it was impossible to make use of any of the methods of measuring the uterine and other forces. This phase of the study therefore had to be abandoned.

In the entire series manual dilatation was employed in only one case which showed no laceration or infection of the cervix in follow-up examination. The hydrostatic bag was employed in 3 cases 2 of which showed lacerations of the more extensive type (3.5 centimeters and 2 centimeters) but no pathological condition in follow-up examination.

In no case was delivery attempted through the partially dilated cervix and in no instance was a pituitary extract used during the first or second stage of labor.

The study is very incomplete therefore as far as the immediate causes of cervical lacerations are concerned.

Incidence of postpartum cervical hemorrhage. Throughout the study every cervix has been carefully examined for immediate postpartum hemorrhage. In the entire series of 324 primiparae there

TABLE VI—RESULTS OF IMMEDIATE TRACHELORRHAPHY

Primiparae 324		Cases	
Number of immediate trachelorrhaphies	1	62	19
Primary failures	5	55	17.3
Number of patients in whom immediate trachelorrhaphy was performed and who later had a labial laceration in the cervix	7	2	4
Number of patients in whom the cervix was lacerated in the second stage of labor	106	6	5.7
Number of immediate trachelorrhaphies	5	81.3	9
Primary failures	1	0.7	
Number of patients in whom immediate trachelorrhaphy was performed and who later had a labial laceration in the cervix	5	83.3	
Number of patients in whom the cervix was lacerated in the second stage of labor	16.7		

were 6 cases an incidence of 1.8 per cent in which the bleeding was considered excessive. There was no postpartum cervical hemorrhage in this series. Despite the low incidence of this complication its seriousness cannot be overestimated and the importance of its immediate recognition cannot be overemphasized. Not infrequently the uterus of a patient who is bleeding excessively following the third stage of labor is packed to control what is believed to be hemorrhage from the body of the uterus while in reality the hemorrhage is from an unrecognized deep cervical laceration. During the past 5 years the author has seen 6 such cases in consultation. In each instance it was necessary several hours after delivery with a patient in surgical shock to remove the uterine pack, resort to blood transfusion and to suture an unrecognized laceration of the cervix. In the light of such an experience it is natural to feel that in all cases of postpartum hemorrhage the operator should be certain that it is not cervical in origin before resorting to uterine tamponade. In the control of cervical hemorrhage primary trachelorrhaphy should be the only treatment to be considered.

#### TECHNIQUE OF IMMEDIATE TRACHELORRHAPHY

Routine examination of the postpartum cervix and immediate trachelorrhaphy are procedures which should be attempted only by those who are thoroughly trained in the art of vaginal plastic surgery as well as in obstetrics. Neither should be attempted elsewhere than in a well equipped delivery room and conducted under aseptic precautions. The use of either of these procedures as a routine in the hands of general practitioners



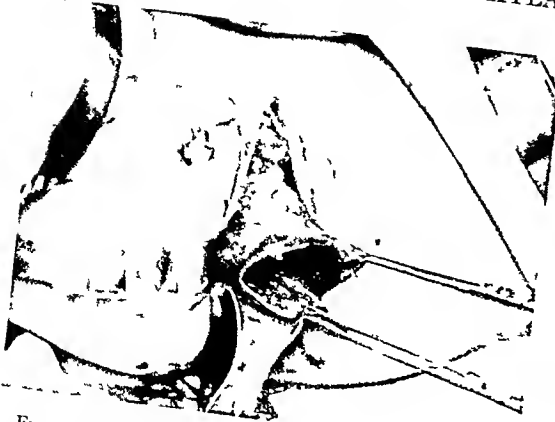


Fig 1 The cervical lips are first seized by sponge forceps in the sagittal plane of the body and are drawn to the introitus. With the forceps so placed it is impossible to recognize lacerations because of the laxity of the tissues in the fully dilated cervix. The forceps are then moved to a paramedian position as shown in Figure 2.

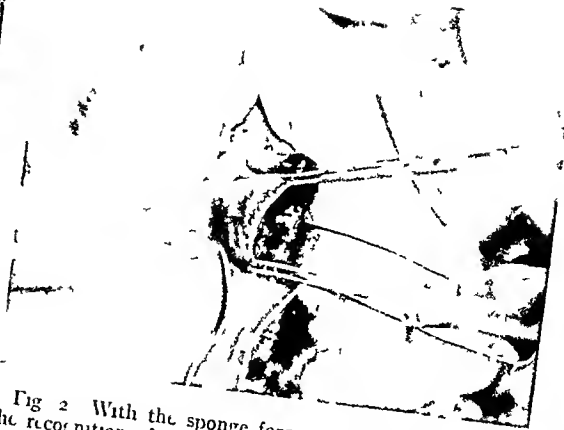


Fig 2 With the sponge forceps placed as illustrated the recognition of cervical injuries is facilitated.

should be discouraged. They are procedures which should not be taught to undergraduate medical students.

Under proper conditions the technique of the operation is as follows. The cervix is exposed as previously described and the injury to be repaired is clearly identified. The raw surfaces are then approximated by means of No. 2 40 day chromic catgut mattress suture (Fig. 3) which has been described by Emge. The author has found this type of suture superior to the ordinary loop-suture employed in the usual trachelorrhaphy, as it is less likely to invert mucosa into the line of union. This type of mattress suture is also more likely to keep the healing surfaces in better apposition than a loop-suture tied at the side of the cervix. Primary trachelorrhaphy should not be attempted in an infected patient unless to control hemorrhage.

Table VI shows the incidence of immediate trachelorrhaphy and the results. From a perusal of this table it is apparent that primary trachelorrhaphy is successful in from 83.3 to 88.7 per cent of the cases in which it is employed. These figures correspond to those reported by others who have written on the subject.

#### TYPE OF DELIVERY

In the entire series of 430 deliveries labor was induced by rupture of the membranes and intramuscular injection of pituitary extract in 3 cases, in 2 instances for toxemia of pregnancy, and in 1 case for placenta prævia.

In 98.1 per cent of 324 primiparæ delivery was preceded by median perineotomy, while in 88.6 per cent of 106 multiparæ the same procedure was employed, 53 per cent of the perineotomies in primiparæ were complicated by involvement of the anal sphincter, but in no instance was the

E. M. Freer

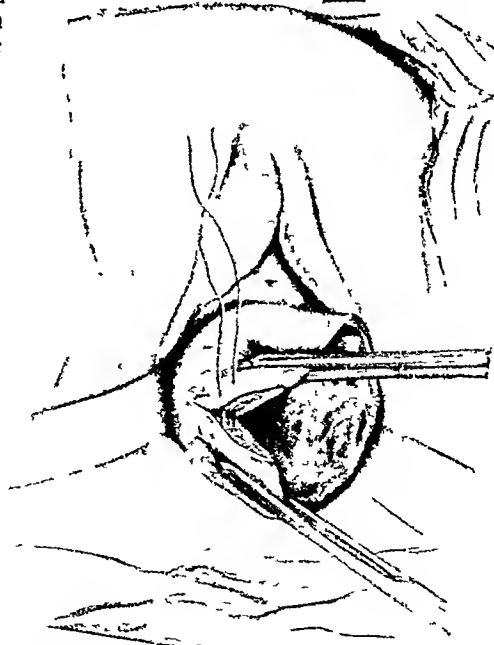


Fig 3 The method of immediate trachelorrhaphy employed in the series of cases under consideration. After Emge.

TABLE VII --TYPE OF DELIVERY

	Pr m parie 54		Mustipa = 6	
	Cases	Per	Cases	Per
Imper d l i t e a	3	00	00	93
P h y l a c t i c l w f u r p o				
S a g t a l t u r t e r o p o a	7	07	60	75
S e t a l u r b l u e	4	3	3	8
M d f o r e s	5	32		9
Scandens		43	3	8
T r i n d b r e c h a c	5	5		9
B e c h t r a c		3	3	8
p o n u a d l e a		6	6	57
I n e m b	32	50	44	886
P n o t m y w h p h n e 77	7	53		0
L a c e r s d e g e e		6	7	66
L a c e r i n a e d e e	3			

lumen of the rectum opened in 1 per cent of the perineotomies in multiparae was complicated by superficial laceration of the anal sphincter with no rectal involvement. Severe infection of a perineotomy wound which later required a secondary operation occurred in 1 primipara. The injured anal sphincter failed to heal properly in 2 of 17 cases in primiparae because of slight separation of the tissues. The union of the sphincter in the only multipara with this complication was primary. There has been no permanent incontinence in any patient who had a laceration of the anal sphincter as a complication of median perineotomy.

Of 124 primiparae 99.4 per cent and 1 of 106 multiparae 94.3 per cent were delivered by operative procedures. 6 per cent of primiparae and 78.2 per cent of multiparae were delivered by a prophylactic low forceps operation.

The term "prophylactic forceps operation" as used in the present study has been applied to that type of forceps operation which is performed for the relief of pressure on the soft parts of the mother and on the child's head as soon as the head has reached the pelvic floor with the sagittal suture in the anteroposterior diameter of the pelvic outlet or almost so. The author is firmly convinced from follow up observations both in private patients and in hospital cases that the relief of such pressure is responsible for a startling reduction of morbidity in both mother and baby.

TABLE VII—MORBIDITY

	Pyriminase				Methylase			
	Cases		M b d		Cases		Methyl	
	N	I	N	F	No.	N	F	
Control	5	6	5	6	5	6	5	6
Control	5	6	5	6	5	6	5	6
Control	5	6	5	6	5	6	5	6

and especially in the incidence of uterine descent, cystocele, rectocele and incontinence of the urinary sphincter. This type of forceps operation in conjunction with the prophylactic incision of the pelvic floor which conserves the rectovaginal septum, the levator ani muscles with their fasciae as well as the structures which constitute the perineal body, has been sponsored especially by DeLee (4). In the opinion of the author it must be regarded as a distinctly conservative procedure rather than a radical one inasmuch as it prevents conditions which were all too prevalent under the method of delivery employed by the devotees of so called conservative midwifery. Table II shows the various types of delivery employed in the series of cases under observation in the present study.

## MORTALITY AND MORBIDITY

**Maternal mortality** In the series of 40 deliveries there has been no maternal death

**Maternal morbidity.** In calculating the maternal morbidity by which is really meant per partum infecti in the standard of the Unitd Med cal Associati n has been adopted. That standard is as follows: The puerperal morbidity should include all fatal cases and also all cases in which the temperature exceed 100 degrees F on any two of the bi daily readings from the end of the first to the end of the eighth day after delivery. This standard has been made more rigid in its application to the present series of cases because of the fact that at the Woman's Hospital all post partum temperatures are read every 4 hours for the first 3 days and twice daily thereafter. If however there is a rise to 99 degrees F 4 h readings are resumed and continued until the temperature is again absolutely normal. In examination of Table I it shows the morbidity in 344 primiparae and in 106 multiparae. In primiparae the morbidity in cases whose cervixes were intact was 6.6 per cent in cases whose cervixes were lacerated from 0.5 to 2.5 centimeters in extent but

TABLE IX.—EROSIONS AND INFECTIONS OF CERVIX END-RESULTS

	Cases		Postpartum erosions		Postpartum infections	
	No	Per cent	No	Per cent	No	Per cent
Primiparae 324 <sup>a</sup> Cervices normal antepartum and intact postpartum	191	58.9	41	21.4	4	2.1
Cervices normal antepartum and lacerated 0.5 to 1.5 cm (not sutured)	33	10.2	8	24.2	2	6.0
Cervices normal antepartum and lacerated more than 1.5 cm Trachelorrhaphy	62	19.1				
Successes	55	88.7	13	23.6	3	5.4
Failures	7	11.3	3	42.8	0	
Multiparae 100 <sup>b</sup> Cervices normal antepartum and intact postpartum	57	53.7	18	31.5	1	1.8
Cervices normal antepartum and lacerated 0.5 to 1.5 cm (not sutured)	4	3.8	2	50.0	0	
Cervices normal antepartum and lacerated more than 1.5 cm Trachelorrhaphy	6	5.6				
Successes	5	83.3	1	20.0	0	
Failures	1	16.7	0		0	

<sup>a</sup> Nulliparae 324 → Antepartum erosions, 32 9.8% → Antepartum infections 11 3.3%

<sup>b</sup> Multiparae 100 → Antepartum erosions 30 3.3% → Antepartum infections 0 0%

were not repaired, the morbidity was 8 per cent, and in cases whose cervixes were deeply lacerated and repaired the morbidity was 16.1 per cent. In multiparae there was a morbidity of 1.1 per cent in cases whose cervixes were intact. There was no morbidity in the small number of cases (16) whose cervixes were lacerated. It is obviously undesirable to attempt to draw conclusions from such a small number of cases. In this series of cases, however, the morbidity rate has been higher in primiparae than in multiparae.

It is obvious, therefore, that patients whose cervixes are moderately or deeply lacerated in labor have a higher incidence of puerperal infection than do those who escape such injury or who have the more superficial type of laceration. The incidence of morbidity seems to be in direct proportion to the degree of injury. It is, of course, impossible to determine how much responsibility is to be placed on the trachelorrhaphy which has been performed on 62 primiparae and in whom there is a morbidity rate of 16.1 per cent. It is significant, however, to note that in no case upon

whom a trachelorrhaphy was performed was there any evidence of an intrapelvic or a blood-stream infection. With such facts in mind, and in the light of an 88.7 per cent incidence of primary union following immediate trachelorrhaphy, it would seem illogical to abandon primary closure of cervical lacerations because of a somewhat higher incidence of temperature elevation such as follows any other surgical procedures without causing undue alarm.

In the series of cases under consideration, vaginal examinations only have been made. No form of chemical sterilization of the vagina has been employed.

**Fetal mortality.** When compiling the fetal mortality rate in the present study, all babies born at the twentieth week of gestation or later have been included. All deaths which occurred during the first two postpartum weeks have also been included. The total number of deaths has been 14 or an uncorrected fetal mortality of 3.2 per cent. The causes of fetal deaths are as follows:

*The causes of stillbirths and neonatal deaths are*

- 1 Cord about the neck Weight 7 pounds
  - 2 Antepartum death of baby Weight 10 pounds 4 ounces
  - 3 Atelectasis Weight 8 pounds 10 ounces
  - 4 Thymus death Third day postpartum
  - 5 Stillborn monster Weight 5 pounds 8 ounces
  - 6 Antepartum death of baby Weight 7 pounds
  - 7 Prolapsed cord Weight 7 pounds 2½ ounces
  - 8 Mongolian idiot Stillbirth Weight 7 pounds
  - 9 Hydrocephalus, fortieth week gestation Weight 8 pounds 10 ounces
  - 10 Antepartum death of baby Weight 7 pounds 12 ounces
  - 11 Prematurity at 22 weeks Weight 2 pounds 2 ounces
  - 12 Tentorial laceration One twin, twenty eighth week of gestation
  - 13 Prematurity Twin, male Weight 1 pound 5 ounces
  - 14 Prematurity Twin, male Weight 1 pound 5 ounces
- Total number of babies 433  
Deaths 14  
Uncorrected mortality rate 3.2 per cent

A follow-up which has extended over a period of from 1 to 8 years, and which has been based on statements from pediatricians as well as upon reports from parents, has shown an incidence of 3 babies in 433 (0.7 per cent) who have shown evidence of conditions the result of intracranial birth injury.

#### END-RESULTS

The follow-up in the present study, as formerly stated, has extended over a period of time ranging from 1 to 8 years. All patients have been examined at the end of the eighth postpartum week at

which time cervical erosions and early cervical infections have with an occasional exception been treated either by cauterization or by electrocoagulation. A second examination has been made at the end of the fourteenth week and a third at the end of a year. It is to be remembered that 106 of the total 324 patients have been delivered a second or third time. Many of the patients have reported for biyearly or yearly gynecological examination over period of time ranging up to 8 years. At each examination special attention has been paid to the condition of the cervix.

Table IX shows the incidence of antepartum and postpartum erosions and infections of the cervix.

In 324 primiparæ 9.8 per cent of the cervixes were eroded and 3.3 per cent were infected antepartum. In multiparæ 8.3 per cent were eroded and 5.6 per cent were infected antepartum. One half of the erosions and all of the infections in multiparæ developed after the eighth postpartum week in service, which were intact and normal at the eighth week examination. The remaining 50 per cent of erosions were untreated remnants from the first labor.

The postpartum incidence of cervical erosion is higher in cervixes which have been lacerated than in those which are intact.

The incidence of postpartum cervical infections in primiparæ is lowest in cervixes intact (2.1 per cent) and highest in cervixes which were lacerated from 0.5 to 1.5 centimeters and not sutured. In the patients whose cervixes were deeply lacerated and were repaired the incidence of infection in a small number of cases is as 5.4 per cent. Though the number of cases is too small to warrant the drawing of a definite conclusion immediate trachelorrhaphy could seem to limit postpartum infections to approximately 3 per cent. It is unfortunate that it is impossible to compare this incidence with that in a group of patients whose cervixes have been deeply lacerated and neglected and later have become infected. It is reasonable to assume that the incidence of infections following neglected lacerations is much higher than in cervixes which have been successfully repaired. It would seem therefore that successful immediate trachelorrhaphy does limit if it does not entirely prevent postpartum infection of the cervix.

To touch upon the postpartum symptoms which have developed in the present series of cases, an unsatisfactory task because of other lesions which have been associated with cervical pathology. There are two outstanding facts, however, which can be safely stated: (1) involution of the uterus

has been delayed in patients whose cervix have been infected in the early puerperium and (2) the restoration of normal menstruation has been considerably delayed in the same type of case.

A relationship between cervical laceration and carcinoma of the cervix has not been established. Many authoritative pathologists deny that cervical laceration is a predisposing factor in the development of malignant change in the cervix. On the other hand many eminent clinicians who have had extensive experience in the treatment of carcinoma of the cervix feel certain that there is a causal relationship between the two conditions. In the cases which have been under observation in the present study there has been no case of carcinoma of the cervix.

#### CONCLUSIONS

1. The cervix of every parturient woman who is delivered under aseptic precautions by a competent obstetrician should be inspected immediately after the third stage of labor for laceration and hemorrhage. Such an examination does not increase the incidence of puerperal morbidity.

2. If the cervix is properly exposed significant cervical lacerations and hemorrhage are detectable.

3. When evaluating the location and extent of a cervical laceration it is important to keep in mind the fact that the left side of the cervix is normally shorter than the right side. This shortening may be explained by the right axial rotation of the gravid womb.

4. In the series of cases herein reported the incidence of cervical lacerations of 0.5 centimeter or more in extent has been 30 per cent in primiparæ and 15 per cent in multiparæ.

5. Cervical lacerations occur more frequently and are more extensive in primiparæ than in multiparæ.

6. Premature rupture of the membranes does not predispose to the production of cervical lacerations.

7. A first stage of labor of more than 12 hours predisposes to cervical laceration.

8. The left side of the cervix is lacerated more frequently than the right side regardless of the position or presentation of the child.

9. The weight of the child has an influence on the incidence of cervical laceration. The larger the child the higher is the incidence of the deeper cervical injuries.

10. The incidence of immediate postpartum cervical hemorrhage in primiparæ has been 1.8 per cent. In multiparæ there has been no cervical hemorrhage.

11 Cervical lacerations of 1.5 centimeters or more in extent should be corrected immediately after the third stage of labor by primary trachelorrhaphy.

12 Postpartum hemorrhage from cervical lacerations should be controlled immediately after the third stage of labor by trachelorrhaphy.

13 Primary trachelorrhaphy should not be practiced in the presence of infection except for the control of hemorrhage.

14 The incidence of primary union following immediate trachelorrhaphy has been 88.7 per cent in primiparæ and 83.3 per cent in multiparæ.

15 Cervical laceration predisposes to an increase in the incidence of puerperal morbidity.

16 In the series of cases under consideration, the incidence of puerperal morbidity has been higher in primiparæ than in multiparæ.

17 The incidence of puerperal morbidity in primiparæ has been 6.6 per cent in cases with cervix intact, 8.1 per cent in cases with cervix slightly lacerated but not repaired, and 16.1 per cent in cases with cervix lacerated and repaired. In multiparæ the incidence has been 1.1 per cent in cases with cervix intact. There has been no morbidity in a small number of multiparæ with lacerated cervixes.

18 There has been no maternal death and no intrapelvic or blood stream infection in any case in the series herein reported.

19 Cervical lacerations predispose to the development of postpartum cervical erosions and infections.

20 The incidence of postpartum cervical erosions in primiparæ has been 21.4 per cent in cervix intact, 24.2 per cent in cervixes slightly lacerated but not repaired, and 23.6 per cent in cervixes lacerated and repaired. In multiparæ the incidence has been 31.5 per cent in cervixes

intact, 50.0 per cent in cervixes slightly lacerated but not repaired, and 20.0 per cent in cervixes lacerated and repaired.

21 The incidence of postpartum cervical infections in primiparæ has been 2.1 per cent in cervixes intact, 6.0 per cent in cervixes slightly lacerated but not repaired, and 5.4 per cent in cervixes lacerated and repaired. The number of cervical lacerations in multiparæ is too small to warrant a conclusion.

22 Immediate trachelorrhaphy, though the immediate and remote results are not ideal, is a valuable prophylactic procedure against postpartum cervical infections and their sequelæ.

23 Immediate inspection of the cervix and primary trachelorrhaphy are procedures which should not be attempted by anyone other than the competent obstetrician who is trained in the art of vaginal plastic surgery. They are procedures which should not be taught to the undergraduate medical student.

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SQUAMOUS CELL EPITHELIOMA OF THE EXTREMITIES<sup>1</sup>

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**C**ONSIDERABLE difference of opinion exists regarding the proper treatment of squamous cell epithelioma of the skin. It has always been the principle at the Stuyvesant Square Hospital to treat this type of cancer by surgical removal. In this paper we will discuss 61 cases of squamous cell epithelioma of the upper and lower extremities treated in this manner.

In a review of the literature for the past 25 years we find very little has been written concerning epithelioma of the extremities. Perez in 1929 discussed the subject, but no large series of cases is reported and very little has been written concerning the metastatic properties of these tumors.

**Incidence.** This lesion is not common. Heifman found 207 cases in 5544 cases of carcinoma. Broders found only 44 cases in 2000 cases of carcinoma admitted to the Mayo Clinic from 1904 to 1915. Of 6766 patients with carcinoma admitted to the Barnes Hospital and the Barnard Skin and Cancer Hospital of St. Louis DeArts in 1916 found only 132 cases of either squamous or basal cell epithelioma of the upper and lower extremities.

During the period from January 1921 to January 1934 at the Stuyvesant Square Hospital 60 patients with squamous epithelioma of the extremities have been treated. One patient had two lesions, one on the leg and a second on the forearm, thus making the total number of cases of epithelioma 61.

**Age.** The youngest patient was 27 years of age when he came under our observation. The oldest was 82 years. The average age was 58.3. The patient with two lesions was 51 years of age. The greatest incidence occurred between the ages of 60 and 69. Table I lists the number of patients found in each decade.

TABLE I—AGE INCIDENCE

Age group	No.
20-29	0
30-39	4
40-49	9
50-59	18
60-69	3
70-79	4
80-89	3

**Sex.** In our group of cases there were 47 males and 13 female, about 3.5 to 1. Broders in his

series of 256 cases of epithelioma of the skin over the entire body had a proportion of 4 to 1. DeArts had 2.5 to 1 in his extremity series.

**Occupation.** This type of tumor seems to be most common among those exposed to trauma, chronic irritation and other predisposing factors of cancer of the skin. There were 21 laborers, 1 sedentary worker, 1 physician, 12 housewives, 1 saleswoman, 13 not mentioned.

**Race.** Twenty-seven of our patients were natives of the United States, 13 were Irish, 1 Italian, 3 Russian and 1 each of the following: Austrian, German, Scotch and English. Charts listed no nationality. There was but one negro and his lesion originated from a burn scar.

**Etiology.** Marjolin as early as 1818 emphasized the fact that carcinoma of the skin not infrequently develops in old scars. Thus an epithelioma developing on scars of burns has for many years been called Marjolin's ulcer. Ewing states that squamous cell epithelioma of the skin is almost invariably the result of chronic traumatism. The early stages may merely be marked by erythema, seborrhea, eczema, pruritus. Chronic ulcer, scars of burns, X-ray dermatitis, lupus, etc., are frequently predisposing factors. Hiltner in 1921 reported a case of squamous cell epithelioma in the sinus of an old osteomyelitis of the tibia. Similar cases have been reported by others.

Broders at the Mayo Clinic in 1911 in a study of 256 cases of squamous cell epithelioma of the skin found the site of the cancer preceded by a mole, wart, pimple, scar, ulcer, leucoplakia, crack, wen, blister or lump in 31.17 per cent of cases. There was a history of injury in 34.5 per cent of cases. Burns represented 24.59 per cent of injuries and X-ray burns represented 5.0 per cent of the burns. DeArts found trauma and burns were the most common etiological factors in epithelioma of the lower extremities. Straker as it may seem epithelioma arising from varicose ulcer is in fact rare. Knox in 1925 stated that accurate reports of only 59 epitheliomas arising in chronic varicose crural ulcers were available at that time.

Thirty or 50 per cent of patients in the series analyzed in this paper gave a history of wart, pimple, fissure or keratosis as the primary lesion. Six or 10 per cent originated in burn scars. Nine or 15 per cent gave a history of some other

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TABLE II—SITE

Total Cases—61

	No	Per cent
A Upper Extremities	51	83.6
Dorsum of hand or wrist	43	
Palm	1	
Forearm and arm	7	
B Lower Extremities	10	16.4
Thigh	6	
Leg and ankle	4	

TABLE III—GRADE DISTRIBUTION

Grade	Number of cases	Per cent of graded
Grade I	35	71.4
Grade II	12	24.4
Grade III	1	2.1
Grade IV	0	0.0
Grade I and II	1	2.1

trauma Two patients stated their lesions followed intensive X-ray therapy, one for psoriasis and the other for trichophytosis One had an extensive lupus with considerable scarring for 30 years, while in 12, or 20 per cent of cases, no mention was made of any previous changes in the skin

*Site* The upper extremity is much more prone to epithelioma than the lower Of our cases 51, or 83.6 per cent of the lesions, were located on the upper limb and 10, or 16.4 per cent, on the lower limb As mentioned previously there was one patient who had two lesions, one on the forearm and the other on the knee By far the greatest number were located on the dorsum of the hand or wrist, there being 43, or 70 per cent, of the total number in this region alone (Table II)

According to some writers, squamous cell epithelioma are fairly common on the foot None in our series was located in this region

*Duration* The average duration of the lesion was 1½ years, the extremes being 3 weeks and 5 years The patient with the history of 3 weeks had a small, papillary, granulating growth on the left forearm which was diagnosed pre-operatively as pyogenic granuloma

*Previous treatment* Thirty-seven of the patients gave a history of some type of previous treatment as follows salves, 13, X-ray, 5, radium, 4, actual cautery, 1, acids, 4, poultices, 1, Alpine light, 2, excisions, 5, curetting, 2

*Description of lesion* The clinical appearance of this type of epithelioma depends to a large extent upon the predisposing factor, whether it be keratosis, burn scar, X-ray dermatitis, lupus, etc., and upon its size The majority of the larger lesions in this series, however, had a crust with a sluggish ulcerating surface, were usually raised above the surface of the surrounding tissue and had a firm, indurated, rolled border The diagnosis

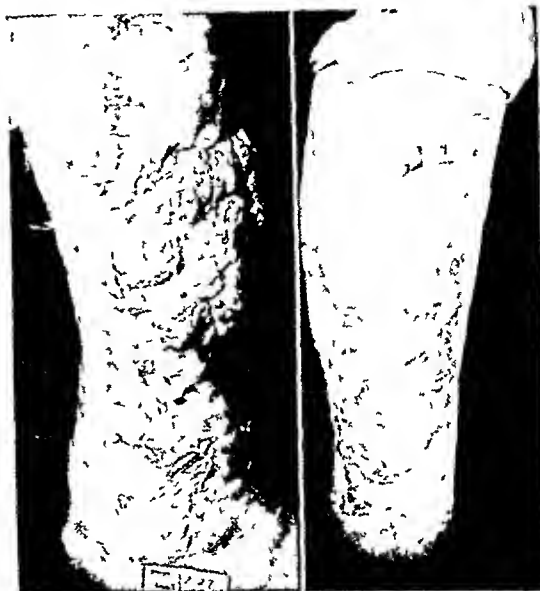


Fig 1, left This ulcerating, fungating lesion began as a "pimple" 3 years before admission to the hospital The clinical diagnosis was squamous cell epithelioma, but the biopsy showed papilloma The lesion was widely excised and Thiersch grafted

Fig 2 Result 1 month after surgical removal of lesion shown in Figure 1 No recurrence in 2 years

was not difficult as a rule, although biopsy was generally resorted to Tuberculosis, actinomycosis, pyogenic granuloma, chronic inflammatory ulcerations, etc., must be differentiated

*Size* The majority of the lesions measured 2 to 4 centimeters in size, the largest being 20 by 8 centimeters and the smallest 1 by 1 centimeter

*Pathology* Histologically all the cases were typical squamous cell epitheliomas Forty-nine, or about 80 per cent, were graded by Dr D S D Jessup, pathologist of the hospital Twelve, or 20 per cent, were not graded, slides and blocks having been accidentally destroyed Those graded all fall in the first three groups as shown in Table III

It is evident that the majority of the tumors are of a low histological grade of malignancy, 80 per cent being either Grade I or Grade II Adair mentions that in a recent article and other writers have called attention to this characteristic

*Treatment* As was brought out earlier in this paper all squamous cell epithelioma of the skin are treated at this hospital by surgical removal This method of cancer therapy is particularly adaptable to lesions on the extremity The exact procedure used depended on (1) the age and general condition of the patient, (2) the size of



Fig 3 The lesion has been present for 3 years. It is fixed to the deep tissues. By the time it reached this stage it was impossible to remove it by conservative means.



Fig 4 Case 4. A 14-year-old girl with a large, dark, irregular lesion on the dorsal surface of the hand. The lesion was removed by amputation.

the lesion (3) the location (4) the fixation to deeper structures (5) the predisposing factors scar tissue X ray dermatitis etc (6) the functional result desired. Since the larger lesions were always grossly infected the usual procedure was gently to remove all crusts several days before the operation and to apply some antiseptic wet dressings such as Dakin's. Under anesthesia as a part of the operation itself the surface of the lesion was cauterized with the electrocautery to sterilize further and to avoid transplantation of the tumor. Then the cancer was excised or amputation was performed. Of the total number of 61 cases 56 were treated by wide excision of the lesion (a 1 to 2 centimeter border of healthy skin surrounding and an uninvolved facial plane beneath). If the tumor was surrounded by scar or X ray dermatitis this was also removed if possible. Only 5 patients required

primary amputation. Three patients in whom the lesions were first excised required subsequent amputation upon recurrence of the cancer. These cases will be discussed later in detail. We found that deep fixation of the lesion did not necessarily eliminate the possibility of excision without amputation for in 5 cases of epithelioma of the dorsum of the hand the tendons were saved with apparent eradication of the cancer even though before operation there seemed to be certain involvement. Several of these patients had been advised by other surgeons that amputation was necessary. An epithelioma as extensive as that shown in Figure 3 was removed in this fashion. The defects left in excision cases were closed whenever possible by simple suture and Thiersch split and full thickness grafts were usually employed if this could not be accomplished. Pedicle flap were used for closure of defects over joints.

Of the 61 cases 13 or 24 per cent were closed with suture, 60 or 55 per cent with Thiersch grafts, 5 or 9.2 per cent with full thickness

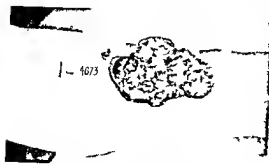


Fig 5 The 14-year-old girl with a large, dark, irregular lesion on the dorsal surface of the hand. The lesion was removed by amputation.



Fig 6 Type 1. A 14-year-old girl with a large, dark, irregular lesion on the dorsal surface of the hand. The lesion was removed by amputation.



TABLE IV—RELATIONSHIP OF PALPABLE REGIONAL NODES TO METASTASES

	Cases
Total number of cases in series	51
Total number of cases with regional nodes dissected	29
Number of dissected nodes palpable before operation	23
Number of dissected nodes not palpable before operation	6
Total number of regional nodes involved (30 per cent of those dissected)	9
Number of involved nodes which were palpable before operation	9
Number of involved nodes which were not palpable before operation	0

grafts, 8, or 14 per cent, of the defects necessitated pedicle flaps of skin and subcutaneous tissue. Pinch grafts were used in 2 cases, and one defect was left to granulate.

**Metastases.** In this series there were no cases with generalized metastases (pulmonary, long bone, etc.). Therefore, we shall limit our discussion to the regional lymph nodes. There are three main groups of these latter regional lymph nodes to be considered: axillary, epitrochlear, and inguinal. The popliteal nodes are usually indefinite. A detailed description of these nodes and of the lymphatic drainage to them can be found in any anatomy text. However, we wish to call attention to the fact that in the hand the lymphatic drainage from the fifth and ring fingers and sometimes the middle finger takes place to the epitrochlear nodes and then to the axillary. Lymphatic drainage from the thumb and index fingers goes directly to the axillary nodes, occasionally to the high deltopectoral group. Hence, in lesions of the ulnar half of the hand, removal of the epitrochlear nodes should be considered.

The operative procedure for regional metastases from lesions of the upper extremity consisted of an excision of the axillary contents (as in a radical mastectomy without the removal of the pectoral muscles), and the fascia from over the upper part of the cephalic vein. The epitrochlear nodes were dissected by excision through a longitudinal incision over the epitrochlear area. A block dissection of the inguinal nodes was performed for lesions of the lower limb. This included the removal of the superficial abdominal fascia and fat beginning several inches above Poupart's ligament, clearing off the spermatic cord, and removal of the fascia of the muscles in Scarpa's triangle. The long saphenous vein was ligated at the lower end of the triangle and at its termination in the femoral vein, and was removed with the lymph nodes in the block of tissue included between the layers of fascia.

TABLE V.—UPPER EXTREMITY AND LOWER EXTREMITY LESIONS AS REGARDS METASTASES

	Cases
Total number of upper extremity cases	51
Total number of lower extremity cases	10

Nodes	Number dissected	Number involved	Per cent involved	Number palpable	Per cent palpable
Axillary nodes	24	4	16.6	13	75
Inguinal nodes	5	4	80	5	100
Epitrochlear nodes	5	2	40	5	100

\*In 1 patient both the axillary and epitrochlear nodes were involved. In the second patient there was epitrochlear but no axillary node involvement. This accounts for the total number of 5 regional node involvements in 9 metastatic cases.

Dissection of palpable nodes was complicated by the fact that the primary lesion was often infected and, as is easily seen, enlargement might be due to this. Some surgeons, therefore, removed the local lesions and then waited (1) to see if there was any recession of the lymphatic enlargement, (2) to decrease the possibility of wound infection in the metastatic dissected areas. We consider this question of involvement and dissection of the lymph nodes to be of primary importance, so we shall discuss our results in detail (Tables I and II).

In other words, it is seen from Table V that all involved nodes were palpable before operation was carried out.

Table V is a comparison of the number of metastases in the upper and lower extremities.

We see from Table V that 24, or 47 per cent, of the total number of 51 upper extremity, and 5, or 50 per cent, of the 10 lower extremity cases had regional node dissections. Four of the 24 axillary node dissections, 4 of the 10 inguinal node dissections, and 2 of the 5 epitrochlear dissections showed metastatic involvement. In other words, of the 24 axillary dissections 16.6 per cent showed involvement, of the 5 inguinal dissections, 80 per cent, of the 5 epitrochlear dissections, 40 per cent. Since so few epitrochlear nodes were dissected, no conclusion can be interpreted from the 40 per cent involvement in this dissection. It is interesting, however, that 1 case showed epitrochlear and no axillary node involvement. From these figures it would seem that lower extremity squamous cell epithelioma is five times more prone to metastasize than upper extremity. (The relative position of the lesions from a comparative standpoint, however, may have something to do with this, all of our lower extremity cases being above the foot, while most of the upper extremity cases were on the hand.)

TABLE VI—RELATIONSHIP OF AGE TO METASTASES

Age group	No. of cases	Dissected	Total
10-9			
3-10-10	4		
10-0	9	5	
5-1-5		6	
60-1-60	8	9	
7-10-70	3		
80-1-80			
Total	4	9	9

As to the relation of palpability of lymph node metastases we found that all cases with node involvement had palpable nodes before operation. On the other hand only 50.2 per cent of those that were palpable and dissected proved to be involved. No cases with non palpable nodes that were dissected were involved.

The average age of patients with metastases was 56 years (Table VI).

From Table VII the following observations are very interesting. The average history of duration was 2 years. All of the metastases were from the larger lesions, the smallest being 3 by 3.5 centimeters. Three patients before admission to the hospital had had X-ray therapy of the primary lesion and 3 had previous excisions. Three cases

which had metastases had lesions which originated in burn scars. This is interesting for of the total number of 61 epitheliomas in the series 6 gave a history of burn scar basis. In other words 50 per cent of the cases originating in burn scars showed metastases. Johnson in 1926 observed that epitheliomas originating in burn scars are very malignant. Each of the 2 patients who had lesions originating in X-ray burns used in previous therapy for skin disease had metastases to the lymph nodes. Both cases with epitracheal metastases were lesions well over on the ulnar side of the hand. There was no definite characteristic clinical appearance to metastasizing lesions. Metastases occurred in all age groups.

**Relation of grading to metastases.** There were 9 cases with metastases (Table VIII). As would be expected taking the total number of cases graded, Grade II metastasized more in proportion than Grade I about 1.75 to 1. It is interesting to note that the only Grade III lesion occurred in a 14 year old grocer and was a lesion approximately 2½ by 2 centimeters on the dorsum of the right hand. This was excised and a Thiersch graft was used to cover the defect. No axillary nodes were palpable and no dissection was done. He has been well for 5 years with no evidence of recurrence.

**Recurrences.** There were 5 patients who had local or metastatic recurrences. Their case histories are briefly presented.

TABLE VII—RELATIONSHIP OF DURATION, ETIOLOGY, PREVIOUS TREATMENT, SIZE AND LOCATION TO METASTASES

Case	Duration	Etiology	Previous treatment	Description	Size in	Location	Age
1	yr	Int. t. and itching	T. blebs, usually	Deep, large, firm, pea-like	5	Ulnar surface of hand	38
2	1 yr.	Ring worm, X-ray	X-ray, 2 yr.	Gran. l. ulcer, F. blebs, 6. Firm, pea-like	3x3.5	Palmar, right hand	87
3	yr	P. 3x3.5 cm.	X-ray, 6.5 yr.	Fung. t. ulcer, not und. by firm, abscess	4x	Dorsal aspect left forearm	43
4	3 yrs.	Burn scar	N	Shallow, ulcer, und. by catrices		Ulnar aspect right hand	5
5	2 yrs.	Burn scar, second burn, 5 yr. old, flowing, brownish scar	On time to and later	Fung. t. ulcer, not und. by firm	8x3.5	Anterior aspect right thigh	38
6	4 mos.	Fung. t. back of hand	Surgical	Carcinoma, bed, ulcer, w. h. used firm margins		Dorsum left hand	8
7	3 yrs.	Burn scars	Surgical, 2 times	Fle. gr. ulcer, 8 yr. old, firm, edges und. by catrices	8	Ulnar aspect right hand	7
8	yr	Unknown	Surgical, previous excision	S. 3x3.5 cm. ulcer, not und. by firm	3x3.5	Ulnar aspect left thigh	3
9	6 mos.	Wart with chronic irrita.	Surgical, previous excision	Shallow ulcer, w. h. und. by firm	3	Dorsum of hand, ulnar aspect	7

TABLE VIII—GRADE AND METASTASES

Cases	Grade
5	I
3	II
1	I and II

CASE 1 J F, a 36 year old crane operator, gave a history of a wart being removed by a private physician and the base cauterized several times. The lesion had been present for 18 months. He had also had X-ray, diathermy and Alpine light previous to cauterization. On admission to the hospital there was found a sharply punched-out ulcer at the base of the right thumb 2 by 3 centimeters in diameter. The clinical impression was squamous cell epithelioma. No axillary or epitrochlear nodes were palpable. A wide excision was made of the lesion, and the defect was closed with a flap from the chest. Pathological report was squamous cell epithelioma Grade I. In a month the flap had not healed entirely and a biopsy showed epithelioma. Amputation of the thumb and first metacarpal and an axillary dissection were performed. The nodes showed no involvement, and the patient made an uneventful recovery. Later the scar on the thumb was traumatized, broke open, and in 1 month a recurrence was noted in the scar, proved by biopsy. Amputation of the lower third of the right arm was performed. Examination of the specimen showed extension of carcinoma along the nerves and vessels of the middle forearm. The epitrochlear lymph node was removed from the supraclavicular region. It showed tuberculosis, no tumor. Five months later the patient complained of pain in the stump of the arm which became swollen and indurated. An acromioclavicular disarticulation was then performed. The patient went into deep shock after the operation and in spite of measures to combat this, he died the next day. The death occurred 2 years after admission, 3½ years after the tumor had been noticed.

CASE 2 M N, a 43 year old American housewife, had psoriasis since she was 15 years of age. Six years before admission she began X-ray treatment for this. One year before admission she noticed a small ulcer on the dorsal aspect of the forearm. This slowly increased in size. On examination she had a mild psoriasis with marked thickening of the skin over the knees and elbows. On the dorsal aspect of the left forearm, there was an ulcer 4 centimeters in diameter surrounded by fungating raised tissue. The clinical impression was squamous cell epithelioma and psoriasis. A wide excision of the lesion with Thiersch graft was therefore performed. Pathological report confirmed the clinical diagnosis. Two months later there was a small recurrence along the margin of the Thiersch graft along the elbow, confirmed by microscopical examination. This was excised. There were a few small axillary nodes felt, so the axilla was also dissected and the nodes were found to be involved with carcinoma. No nodes were left in the epitrochlear region, so no dissection was done there. The arm and axilla healed and the patient has been well for five years.

CASE 3 M R, a 50 year old Italian housewife, burned her right thigh 3 years before admission to the hospital. This never healed entirely. When she entered the hospital, the entire lateral aspect of the right thigh showed marked cicatrices, in the center of which was an area of ulceration 12 centimeters in diameter with raised, hard margins. Near this area of ulceration several small nodules were also noted under the skin. There were palpable, hard inguinal lymph nodes. Clinical impression was squamous cell epithelioma with local skin and inguinal node metastases. Wide excision of the lesion with extensive Thiersch graft was done. Two months later a small recurrence was noted on the border of the Thiersch graft. This was excised and dissection of the inguinal lymph nodes was performed. The nodes were found to be involved. The wounds healed and the patient was well for 14 months when the area of Thiersch began again to break down. A

biopsy showed recurrence. This was excised and the defect was covered with Thiersch graft. Ten months later another area of tumor appeared at the margin of the graft. Patient refused operation and has not been heard of since.

CASE 4 J H, a 78 year old white male clerk, had had an itching keratosis on the right forearm for several years. One year before admission a small ulcer developed which slowly increased in size. He received no local treatment except salves. On examination there was a deep ulcer with firm, pearly, raised margin, 4 by 5 centimeters in diameter on the ventral surface of the right forearm. There were no palpable axillary or epitrochlear lymph nodes. Clinical impression was squamous cell epithelioma. A wide excision under local anesthesia was performed, the defect being covered with a Thiersch graft. Three months later there was still a granulating area present at the base of the Thiersch graft and a moderate edema of the forearm was noted. There were also swellings in the axillary and epitrochlear regions. The patient was treated conservatively for a time with no improvement, so a disarticulation of the arm at the shoulder and an axillary node dissection was performed under colonic anesthesia. The pathological report showed involvement of axillary and epitrochlear nodes. The patient made an uneventful recovery, and in 5 months was entirely healed. One month later he developed a severe cold and died a few days later. A postmortem examination was not done. It was said by relatives that there was no evidence of local recurrence of the carcinoma at the time of his death.

CASE 5 H M, a 29 year old white male, burned the right leg and thigh at 5 years of age, the wounds requiring skin grafts. Three years before admission the right thigh was injured in an automobile accident, necessitating further skin grafts. The wounds healed but broke down repeatedly. On the admission to the hospital the right thigh showed two areas of ulceration involving almost its entire lateral aspect (See Fig 4). The margins of the ulcers were markedly indurated and were surrounded by dense scar and atrophy. Several hard lymph nodes were palpable in the right groin. The clinical impression was squamous cell epithelioma of the right thigh with metastases to the inguinal lymph nodes. A wide excision of the lesions and an inguinal node dissection was performed. The pathological report confirmed the clinical diagnosis. The wound of the thigh was subsequently covered with Thiersch grafts but did not heal. A year later the wounds of the thigh had not healed and a biopsy showed recurrence. The entire granulating area of the thigh was widely excised and again covered with Thiersch grafts. The grafts did not heal and 6 weeks later an amputation of the thigh just below the greater trochanter was performed. The wound healed by primary union. It is still too early, 9 months, to report a final result on this case.

# OBSERVATIONS FROM STUDY

From a study of the recurrent cases which are given the following observations may be made

Three of the cases showing recurrence were graded I, a fourth was graded II, and a fifth, I and II

# SURGERY GYNECOLOGY AND OBSTETRICS

TABLE IX—FOLLOW UP

Years with recurrence	Cases
5 or more	5
4	1
3	6
2	6
1	9
Less than 1 year	5
Total	(72%) 46
Follow up	

Each recurrence was in a different age group. Three recurrences had secondary amputation and a fourth required it but refused the treatment which was suggested.

It appears that recurrent lesions should be treated more radically than primary lesions.

Two of the recurrences Cases 1 and 4 showed extensive lymphatic permeation on examination of the specimens.

Regional nodes should be dissected when the local lesion recurs.

Four of the recurrent cases showed regional node involvement the fifth showed tuberculosis.

Recurrences appeared from 1 month to 2 months after the primary operation. There have been to our knowledge no late recurrences.

**End results.** Due to the type of patient treated at the Stuyvesant Square Hospital, a total of 16 patients could not be located. Most of these patients were treated a number of years ago. Table IX includes the follow up results.

The 3 others are accounted for as follows:

- 1 J F discussed under Recurrence No 1 died of recurrence 2 years after admission.
- 2 M R discussed under Recurrence No 3 had a recurrence refused operation and disappeared.
- 3 N C had a severe cardiac condition and died of auricular fibrillation 3 weeks after operation while at home the wound was entirely healed.

These figures might further be modified in their interpretation by the fact that 16 patients died before the 5 year period following operation had passed but to the best of our knowledge only 1 of the group died of recurrence. The 15 others died from some other cause heart disease pneumonia tuberculosis etc. The number of five year cures therefore might have been considerably larger had this group not been so high. We can infer from these figures however that the chance of curability of epithelioma of the extremities is very high with surgical methods. We believe therefore that surgery is the procedure of choice for the treatment of this type of tumor.

Of the cases which had metastases in the regional nodes as proved by regional node dissections we know 4 of the 9 are well after 5 years. Of the 5 remaining 2 have not as yet reached the 5 year follow up period 1 died from shock following operation for local recurrence 1 died of pneumonia 6 months following treatment, and 1 patient has been lost track of. In other words even with metastases in the nodes there were about 45 per cent established 5 year cures and as has been brought out previously this figure must unquestionably be much below the actual facts.

## SUMMARY AND CONCLUSIONS

- 1 Sixty one cases of squamous cell epithelioma of the extremities are discussed. Fifty one were on the upper limb and 10 on the lower.
- 2 Squamous cell epithelioma. It is not a common type of tumor.
- 3 Squamous cell epithelioma. It is found chiefly in those of the cancer age.
- 4 Because of the predisposing factors the type of tumor is more common in men.
- 5 By far the greatest number 43 appeared on the dorsum of the hand.
- 6 The majority are Grade I histologically.
- 7 Duration of the lesion seems to have no relationship to metastasis.
- 8 Metastases to regional lymph nodes were found only in cases with larger lesions the smallest being 3 by 3½ centimeters in diameter.
- 9 All lymph nodes showing metastases were palpable before operation.
- 10 Dissection of epitrochlear lymph nodes should be considered if the lesion extends over the ulnar aspect of the hand.
- 11 Routine dissection of regional nodes in cases of epithelioma originating in burn scars is advocated.
- 12 Dissection of regional nodes should be performed in recurrent cases.
- 13 Although the number of cases of epithelioma on the lower extremities is not large it appears that these are more likely to metastasize than lesions on the upper extremities.
- 14 There were no cases with generalized metastases.
- 15 Surgical removal is a satisfactory method of therapy.

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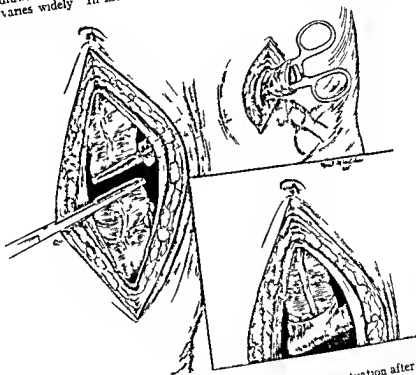
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A PRECAUTION IN STAB WOUND COLOSTOMY<sup>1</sup>

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MANY of the commonly used radical operations for carcinoma of the rectum involve the formation of an end colostomy in a stab wound. The exact technique of division of the bowel and withdrawal of the distal end of the proximal segment varies widely. In most cases

grasp the bowel at the selected point of division in closing the clamp on the bowel care should be taken not to catch the rubber tubing. Another clamp is placed distal to the first through the main wound and the bowel is divided between the clamps with the electric cautery. The illus-



the bowel is divided with the cautery between crushing clamps. Some authors withdraw the proximal segment through the stab wound without more ado. Others to avoid the possibility of contaminating the peritoneum or the walls of the stab wound have turned in the bowel end with sutures or have covered the bowel end with a piece of rubber dam tied securely over the raw surface. The present procedure was devised to simplify covering of the raw surface of the proximal segment during its withdrawal. The straight Ochsner clamp is threaded through a 6 inch strip of 1 inch Miller tubular rubber wick. Then it is passed through the stab wound to

illustration pictures the situation after division of the bowel. The end of the rubber tubing is now drawn down over the end of the clamp and the adjacent bowel as shown in the inset. The tubing should be long enough so that the other end still protrudes from the stab wound with the handle of the clamp. The bowel can then be withdrawn through the stab wound with perfect safety and great facility.

We have used this procedure repeatedly with complete satisfaction and with an appreciable saving of time as compared with other methods which have been devised to cover the raw surface during withdrawal.

# SUDDEN OCCLUSION OF THE ARTERIES OF THE EXTREMITIES

## A STUDY OF 100 CASES OF EMBOLISM AND THROMBOSIS<sup>1</sup>

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THE integrity of an extremity is dependent to a large degree on the adequacy of circulation in large arteries, for tissue may die when the supply of blood is greatly and quickly diminished. Sudden arterial occlusion is catastrophic in the sense that loss of the extremity is a possibility. Furthermore, death may supervene, for amputation necessitated by gangrene is not without risk. Embolism in the extremities may be only one event of many which may affect more vital structures and cause the patient's death.

Unfortunately, the recognition of sudden arterial occlusion is not as efficient as desired, treatment is often ill advised, or, when rational, is too long delayed. Considerable confusion exists regarding the symptoms of sudden arterial occlusion, the cause of pain, the mechanism of ischemia, and the ultimate outcome. It is with the hope that some of the deficiencies noted may be clarified that our study is presented.

### MATERIAL STUDIED

Our data consist of 100 cases of sudden arterial occlusion observed at The Mayo Clinic from 1924 to 1933, inclusive. These are by no means all the cases in which sudden arterial occlusion occurred among patients under the supervision of physicians of the clinic during the time mentioned, for occasionally, when other conditions exist, such as heart disease or chronic occlusive arterial disease, or when the arteries which are occluded are small, sudden arterial occlusion is not mentioned as part of the diagnosis. As will be noted later, this deficiency probably influences our data regarding recovery from sudden arterial occlusion. Throughout this paper the terms "embolism" and "thrombosis," when applied to our material, indicate the apparent diagnosis. No methods exist for differentiating these two conditions with absolute certainty.

### ETIOLOGY

The arteries of the extremities may be occluded suddenly as a result of embolism or thrombosis (Table I). The heart is the chief source of emboli. Disease of the aortic or mitral valves and thrombosis on the walls of the heart due to any cause

may give rise to the detachment of thrombi and their transportation by the blood to the peripheral arteries, which suddenly become occluded. An embolus of cardiac origin is more likely to develop when irregularities of rhythm, such as auricular fibrillation or flutter, exist than when the rhythm is normal. A presentation of the various types of heart disease which may lead to embolism is beyond the scope of this paper. The subject has been reviewed adequately by Willius. It is hardly necessary to mention the transportation of a clot from the veins through a patent foramen ovale, as this must occur extremely rarely.

A thrombus on the walls of the arteries of the greater circulation may give rise to embolism distally. Such thrombi may occur in aneurisms, on arteriosclerotic plaques, as a result of injury and inflammation. The sclerotic aorta is a common source of an embolus. At necropsy one may observe numerous examples of projection of plaques into the lumen, and thrombi around these projections are not uncommonly observed (Fig. 1). In specific instances, in which no other disease of the heart or large arteries can be demonstrated, the emboli probably originate from thrombi on the walls of the arteries.

Local thrombosis may occur suddenly in the arteries themselves owing to a number of causes. Symptoms of sudden arterial occlusion occur in about 10 per cent of cases of thrombo-angitis obliterans. Just why the symptoms of this final event are acute in some cases and of gradual onset in others cannot be stated. The different results seem to represent variations in the speed of the process, in the size of the artery involved, and in the extension of the thrombus. In periarteritis nodosa, thrombosis occurs, but usually the process is one of days rather than hours. However, it seems advisable to include this disease in our classification. Mycotic arteritis, or the effect of bacterial toxins on the walls of arteries, appears to account for sudden occlusion occurring in severe infections such as septicemia, pneumonia, peritonitis, and more rarely in such conditions as tuberculosis and influenza. There may be an additional factor of increased coagulability of the

<sup>1</sup>Abridgment of thesis submitted by Dr. McKechnie to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

TABLE I—THE ETIOLOGICAL CLASSIFICATION OF SUDDEN ARTERIAL OCCLUSION (ALLEN)

Embolism	(Circulation)	(Arteries)	(Veins)
	(Atherosclerosis)	(Thrombosis)	(Thrombosis)
Thrombosis	(Atherosclerosis)	(Thrombosis)	(Thrombosis)
	(Atherosclerosis)	(Thrombosis)	(Thrombosis)
Ligation and laceration	(Atherosclerosis)	(Thrombosis)	(Thrombosis)
	(Atherosclerosis)	(Thrombosis)	(Thrombosis)

TABLE II—THE CAUSES OF SUDDEN ARTERIAL OCCLUSION

Hart disease	Patent foramen ovale	Operative factors	Foliar degeneration	Ligation	Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis
Patent foramen ovale	Operative factors	Foliar degeneration	Ligation	Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis
Operative factors	Foliar degeneration	Ligation	Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis
Foliar degeneration	Ligation	Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Ligation	Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Infarction	Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Cervical rib	Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Isthmorrhage	Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Embolism	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis
Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis	Thrombosis

blood hence this type of sudden arterial occlusion is classified likewise under thrombosis of hematogenic origin. In generalized infections such as septicemia the original lesion is apparently inflammation of the arteries which leads to thrombosis. Arteriosclerosis of the arteries of the greater circulation causes thrombosis by roughening of the intima or projection of atheromatous plaque into the lumen of the artery. As in thromboangitis obliterans the final stage of occlusion is always thrombosis and similarly evidence is not at hand to explain why the symptoms are of sudden onset in some cases and gradual in others. Only about 10 per cent of cases of arteriosclerosis obliterans are characterized by sudden occlusion. Thrombosis may likewise occur as a result of external trauma such as that which occurs as a result of large cervical ribs, gunshot and stab wounds and as a sequel to every injury to an extremity or unusual effort. The latter factor may produce thrombosis by causing projection of a calcareous plaque into the arterial lumen.

One of the most interesting causes of sudden arterial occlusion is increased coagulability of the blood or thrombophilia a syndrome which has been described by Nygaard and Brown who reported 5 cases. According to these authors the characteristics of this condition are sudden occlusion of large arteries and veins of apparently normal subjects absence of the usual clinical features that characterize the chronic occlusive arterial diseases and embolism minimal pathological changes in the involved vessels changes in coagulation of the blood occurring during episodes of thrombosis and multiple areas of thrombosis which are not ordinarily observed in other diseases characterized by thrombosis.

Ligation of arteries may be necessitated by injury during operations and rarely they may be severed accidentally during a surgical procedure as a result of external injury. While severance of an artery is not sudden arterial occlusion in the strictest sense of the term the physiological interruption of the continuity of the lumen of the artery is the same as that which occurs in organic occlusion.

Sudden occlusion of arteries of the extremities may occur following operations during which the main arteries are not apparently injured. Perhaps it results from extension of thrombus into the main arteries from smaller branches. This is not always a possibility however as is evidenced by a case of sudden occlusion of the arteries of the left arm following resection of the stomach for carcinoma. In this specific case in which the patient was a woman 65 years old it was assumed that the slowed blood stream subsequent to partial amputation of the extremity following operation led to the deposition of a thrombus on a sclerotic mural plaque. Naturally causes effective at any time may cause sudden occlusion following operation. Malignant cells may invade arteries and may possibly cause occlusion of the arteries of the extremities. We can offer no direct evidence of this although the process has been described in the pulmonary arteries by Greenspan. In 2 of the cases mentioned in this report there was an associated extensive malignant involvement of the pelvic structures. These instances of sudden occlusion of arteries of uncertain origin are included under the term miscellaneous.

The determination of the exact cause of sudden arterial occlusion is not always easy. When dis-



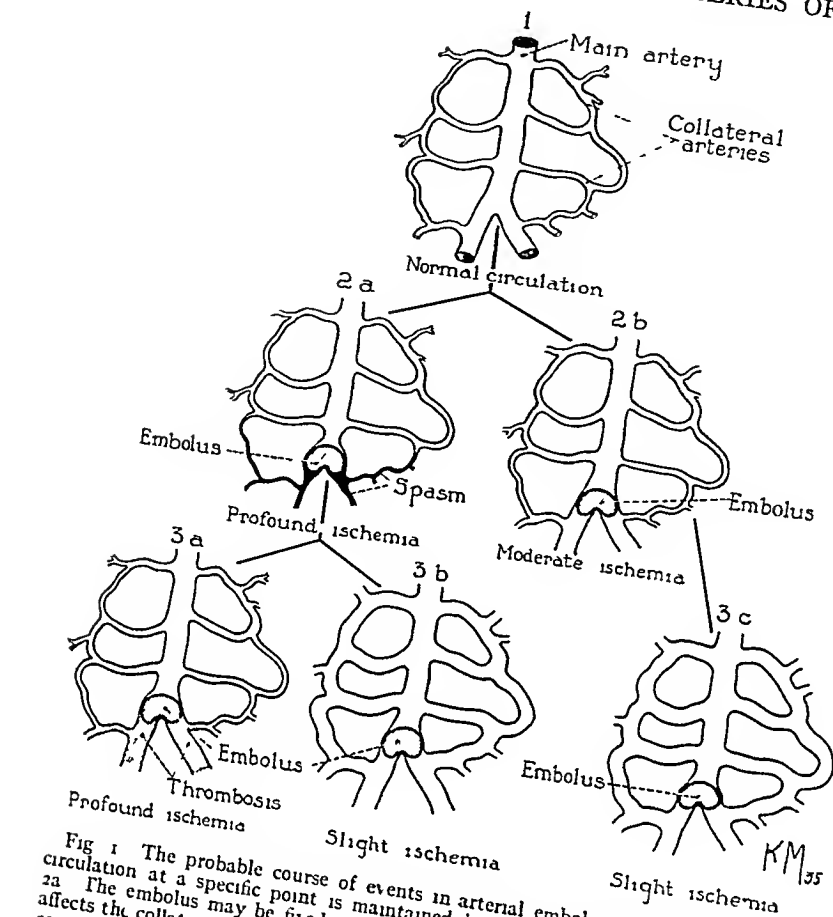


Fig. 1 The probable course of events in arterial embolism. 1 Normal arterial circulation at a specific point is maintained by the main and collateral arteries. 2a The embolus may be fixed at the point of lodgment by spasm, which likewise affects the collateral arteries, producing profound ischemia as both arterial pathways are occluded. 2b If spasm does not occur, only moderate ischemia results, since the collateral arteries continue to function. 3a If arterial spasm persists for a considerable period, widespread arterial thrombosis results when the spasm disappears, since the intima has been greatly damaged by prolonged ischemia. Under these circumstances there is profound diminution in the blood supply to the extremity. 3b If arterial spasm is relieved promptly and the function of the collateral arteries is increased the resulting ischemia is only slight in spite of the fact that the main pathway is occluded. 3c When arterial embolism does not result in spasm, the circulation can be greatly improved by increasing the function of the collateral arteries, only slight ischemia results.

ease of the heart is present, and particularly if it is associated with disturbances in rhythm, sudden occlusion of the arteries can usually be attributed to an embolus from the heart. When it occurs in the presence of characteristic evidence of thrombo-angitis obliterans or arteriosclerosis obliterans such as antecedent symptoms of these diseases and evidence of slow occlusion of arteries in other extremities, and the absence of other obvious causes, sudden arterial occlusion can safely be

attributed to thrombosis occurring as a part of the diseases mentioned. It is when no obvious cause exists that difficulty is encountered in explaining the situation. Then the best one can do is to hazard a guess after all available information is considered. Fortunately, the determination of the exact cause is secondary to rational treatment of the diminished blood supply resulting from the occlusion. The various etiological factors in our cases are summarized in Table II.

TABLE III—THE SYMPTOMS OF SUDDEN ARTERIAL OCCLUSION

Embolism (46 cases)			Thrombosis (34 cases)		
Symptoms occurred acutely in cases	cases	First noted, cases	Symptoms occurred acutely in cases	cases	First noted, cases
Pain	33	7			
Numbness	0	3			3
Coldness	4	6	1		3
Tingling	5				
Tenderness	2				
Cramps			3		3
Itching					
Pulse					
Swelling			3		
Fullness			4		
Ulceration	4		6		

When did the symptoms first appear?  
 (Time in hours)  
 1-2 3-4 5-6 7-8 9-10 11-12 13-14 15-16 17-18 19-20 21-22 23-24 25-36 37-48 49-72 73-96 97-120 121-144 145-168 169-192 193-216 217-240 241-264 265-288 289-312 313-336 337-360 361-384 385-408 409-432 433-456 457-480 481-504 505-528 529-552 553-576 577-600 601-624 625-648 649-672 673-696 697-720 721-744 745-768 769-792 793-816 817-840 841-864 865-888 889-912 913-936 937-960 961-984 985-1008 1009-1032 1033-1056 1057-1080 1081-1104 1105-1128 1129-1152 1153-1176 1177-1200 1201-1224 1225-1248 1249-1272 1273-1296 1297-1320 1321-1344 1345-1368 1369-1392 1393-1416 1417-1440 1441-1464 1465-1488 1489-1512 1513-1536 1537-1560 1561-1584 1585-1608 1609-1632 1633-1656 1657-1680 1681-1704 1705-1728 1729-1752 1753-1776 1777-1800 1801-1824 1825-1848 1849-1872 1873-1896 1897-1920 1921-1944 1945-1968 1969-1992 1993-2016 2017-2040 2041-2064 2065-2088 2089-2112 2113-2136 2137-2160 2161-2184 2185-2208 2209-2232 2233-2256 2257-2280 2281-2304 2305-2328 2329-2352 2353-2376 2377-2400 2401-2424 2425-2448 2449-2472 2473-2496 2497-2520 2521-2544 2545-2568 2569-2592 2593-2616 2617-2640 2641-2664 2665-2688 2689-2712 2713-2736 2737-2760 2761-2784 2785-2808 2809-2832 2833-2856 2857-2880 2881-2904 2905-2928 2929-2952 2953-2976 2977-3000 3001-3024 3025-3048 3049-3072 3073-3096 3097-3120 3121-3144 3145-3168 3169-3192 3193-3216 3217-3240 3241-3264 3265-3288 3289-3312 3313-3336 3337-3360 3361-3384 3385-3408 3409-3432 3433-3456 3457-3480 3481-3504 3505-3528 3529-3552 3553-3576 3577-3600 3601-3624 3625-3648 3649-3672 3673-3696 3697-3720 3721-3744 3745-3768 3769-3792 3793-3816 3817-3840 3841-3864 3865-3888 3889-3912 3913-3936 3937-3960 3961-3984 3985-4008 4009-4032 4033-4056 4057-4080 4081-4104 4105-4128 4129-4152 4153-4176 4177-4200 4201-4224 4225-4248 4249-4272 4273-4296 4297-4320 4321-4344 4345-4368 4369-4392 4393-4416 4417-4440 4441-4464 4465-4488 4489-4512 4513-4536 4537-4560 4561-4584 4585-4608 4609-4632 4633-4656 4657-4680 4681-4704 4705-4728 4729-4752 4753-4776 4777-4800 4801-4824 4825-4848 4849-4872 4873-4896 4897-4920 4921-4944 4945-4968 4969-4992 4993-5016 5017-5040 5041-5064 5065-5088 5089-5112 5113-5136 5137-5160 5161-5184 5185-5208 5209-5232 5233-5256 5257-5280 5281-5304 5305-5328 5329-5352 5353-5376 5377-5400 5401-5424 5425-5448 5449-5472 5473-5496 5497-5520 5521-5544 5545-5568 5569-5592 5593-5616 5617-5640 5641-5664 5665-5688 5689-5712 5713-5736 5737-5760 5761-5784 5785-5808 5809-5832 5833-5856 5857-5880 5881-5904 5905-5928 5929-5952 5953-5976 5977-6000 6001-6024 6025-6048 6049-6072 6073-6096 6097-6120 6121-6144 6145-6168 6169-6192 6193-6216 6217-6240 6241-6264 6265-6288 6289-6312 6313-6336 6337-6360 6361-6384 6385-6408 6409-6432 6433-6456 6457-6480 6481-6504 6505-6528 6529-6552 6553-6576 6577-6600 6601-6624 6625-6648 6649-6672 6673-6696 6697-6720 6721-6744 6745-6768 6769-6792 6793-6816 6817-6840 6841-6864 6865-6888 6889-6912 6913-6936 6937-6960 6961-6984 6985-7008 7009-7032 7033-7056 7057-7080 7081-7104 7105-7128 7129-7152 7153-7176 7177-7200 7201-7224 7225-7248 7249-7272 7273-7296 7297-7320 7321-7344 7345-7368 7369-7392 7393-7416 7417-7440 7441-7464 7465-7488 7489-7512 7513-7536 7537-7560 7561-7584 7585-7608 7609-7632 7633-7656 7657-7680 7681-7704 7705-7728 7729-7752 7753-7776 7777-7800 7801-7824 7825-7848 7849-7872 7873-7896 7897-7920 7921-7944 7945-7968 7969-7992 7993-8016 8017-8040 8041-8064 8065-8088 8089-8112 8113-8136 8137-8160 8161-8184 8185-8208 8209-8232 8233-8256 8257-8280 8281-8304 8305-8328 8329-8352 8353-8376 8377-8400 8401-8424 8425-8448 8449-8472 8473-8496 8497-8520 8521-8544 8545-8568 8569-8592 8593-8616 8617-8640 8641-8664 8665-8688 8689-8712 8713-8736 8737-8760 8761-8784 8785-8808 8809-8832 8833-8856 8857-8880 8881-8904 8905-8928 8929-8952 8953-8976 8977-9000 9001-9024 9025-9048 9049-9072 9073-9096 9097-9120 9121-9144 9145-9168 9169-9192 9193-9216 9217-9240 9241-9264 9265-9288 9289-9312 9313-9336 9337-9360 9361-9384 9385-9408 9409-9432 9433-9456 9457-9480 9481-9504 9505-9528 9529-9552 9553-9576 9577-9600 9601-9624 9625-9648 9649-9672 9673-9696 9697-9720 9721-9744 9745-9768 9769-9792 9793-9816 9817-9840 9841-9864 9865-9888 9889-9912 9913-9936 9937-9960 9961-9984 9985-10000

## SYMPTOMS

It is a common belief among physicians that sudden arterial occlusion is characterized at onset by an abrupt attack of excruciating pain. That this is true in some cases cannot be denied but our data indicate unequivocally that the symptom mentioned is an inconstant companion of sudden arterial occlusion. We wish to stress parenthetically that it is dogmatic adherence to this old criterion of arterial embolism or thrombosis that contributes to inadequate or inaccurate diagnosis and the poor treatment which invariably follows. The diagnosis of arterial occlusion is easy when gangrene is obvious and it is then equally futile. *Diagnosis must be made early.* This necessitates a knowledge of the early symptoms of sudden arterial occlusion for suspicion that it exists must encourage the examination which permits the diagnosis.

In 47 per cent of our cases (Table III) the symptoms appeared suddenly and reached their maximal intensity quickly. In the remaining cases the development of symptoms was gradual requiring from one hour to several hours to reach a full development. These figures emphasize the fact that the symptoms of sudden arterial occlusion do not always occur abruptly. In only 54 per cent of cases was pain the initial symptom. On the basis of these data sudden arterial occlusion would be suspected in only about half of the

cases in which it had occurred if abrupt pain was considered the only symptom of importance. Numbness coldness and tingling may be paramount symptoms either occurring singly or in varied combinations with pain and with each other. Loss of muscular power amounting in some instances to total paresis is rarely noted by the patient. This is due apparently to the natural tendency to immobilize a painful extremity. We do not know definitely the explanation for the varied symptoms noted but it is probably intimately linked with the suddenness and extent of the organic occlusion and the degree of arterial spasm associated with it.

There is very little of importance in the general symptomatology. When serious organic disease exists such as valvular heart disease associated with decompensation for example symptoms of it dominate the clinical picture. Individuals who are not seriously ill previously manifest varying degrees of tachycardia and anxiety. The body temperature is rarely significantly altered. When severe pain exists the faces are drawn and pallid perspiration may be profuse.

The duration of symptoms after sudden arterial occlusion is variable. If marked vasodilation is induced soon after the onset the symptoms may be relieved promptly and completely as reported by Herrmann and Reid, Denk and Allen and MacLean who used intermittent suction and pressure and papaverine. If these methods are not used the major symptoms may disappear in from 24 to 72 hours. This cessation of symptoms may indicate eventual recovery or eventual gangrene. When gangrene is definitely established the symptoms are ordinarily mild. In cases in which sudden arterial occlusion does not lead to gangrene the symptoms due to sudden occlusion may merge unperceptibly into those of ischemic neuritis described by Goldsmith and Brown. The pains tend to be paroxysmal and severe and to cover large areas which do not correspond to any definite nerve distribution. They may persist for weeks or months.

Even when ischemic neuritis does not occur there are ordinarily some evidences of residual impairment of circulation such as vasomotor changes coldness intermittent claudication by paresthesia and so forth.

## DIAGNOSIS

The incidence of diagnosis of sudden arterial occlusion parallels roughly the suspicion by the physician that it exists. If one examines the extremities for the condition only when severe pain pallor and coldness exist many cases will

be overlooked. As stated in the preceding paragraphs, the symptoms are frequently minimal and bizarre. The habit of examining the arteries of an extremity for pulsations when distress exists is a valuable one, and the procedure should be carried out routinely under the circumstances noted. It is an unfavorable commentary on this phase of diagnosis that the physical examination often is considered complete although no notation is made of the state of pulsations in the arteries of the extremities. A comparable situation would be failure to examine the heart when the patient complains of dyspnea.

The symptoms indicative of sudden arterial occlusion have been mentioned previously. The chief findings are absence of pulsation in some of the acral arteries in which pulsations were previously present, lowered surface temperature, pallor, and the loss or diminution of reflexes, sensation, and muscular strength.

Easily palpable under ordinary circumstances are the brachial, radial, femoral, popliteal, dorsalis pedis, and posterior tibial arteries. Some practice is required to feel pulsations in the ulnar arteries of normal subjects. In obese subjects, determination of the state of pulsations, particularly those in the brachial, ulnar, popliteal, and posterior tibial arteries may be more difficult. In spite of these difficulties, the absence of pulsations in arteries which were known or assumed to have been palpable previously is the most important diagnostic sign. Observation of this abnormality in conjunction with lowered surface temperature and pallor of an unusual degree is pathognomonic of arterial occlusion. Additional findings of hyperesthesia, anesthesia, or paresis are confirmatory. Thermometers are not needed to determine lowering of the surface temperature, which can be estimated with sufficient accuracy by alternately placing the back of the hand on the normal and diseased extremities.

Thrombophlebitis is the only condition which may be differentiated with difficulty from sudden arterial occlusion. Ordinarily the normal temperature, edema, distended veins, and normal arterial pulsations observed in cases of thrombophlebitis serve as an adequate contrast to the lowered temperature, collapsed veins, and diminished or absent pulsations in the arteries in cases of sudden arterial occlusion. However, we have observed that arterial pulsations may be absent temporarily in phlebitis, apparently as a result of spasm. Pallin observed such an occurrence during operation for supposed embolism. He observed that the femoral vein was thrombosed and that the femoral artery was occluded by spasm. In sud-

den arterial occlusion the veins may be distended, usually after many hours have elapsed, as a result of secondary venous thrombosis. Under such circumstances close attention must be given to the mode of onset and the known possibilities of embolism. In rare instances the diagnosis may not be clear until many hours have elapsed.

Localization of the embolism is usually not difficult and is of importance only when embolectomy is contemplated, or from a prognostic standpoint. Knowledge that emboli usually lodge at bifurcations, owing to the fact that the emboli will lodge at a point where the caliber of the artery is suddenly reduced, is of importance. Palpation is likewise of primary value in localizing areas of sudden arterial occlusion. The point of sudden arterial occlusion is just distal to the area where normal pulsations are noted. Unfortunately for extreme accuracy the anatomical arrangement of arteries does not allow palpation of them throughout their entire course. Extreme tenderness over the area of occlusion is not uncommon. The line at which the temperature of the skin changes from low to normal is likewise of importance, and it can be determined by passing the back or side of the hand proximally from the distal portion of the extremity. This line is located roughly just above the ankle in occlusion of the popliteal artery, and at the juncture of the lower and middle thirds of the thigh in occlusion at the bifurcation of the femoral artery. When the common iliac artery is occluded, the point is located at about the juncture of the middle and upper thirds of the thigh. Similar relationship of the location of the embolus and the line of sharp change in temperature is observed in the upper extremity. Diminution or loss of motor power and sensation, when it occurs, is ordinarily distal to the line of sharp change in the temperature of the extremity. When arteries are paired, as the radial and ulnar or dorsalis pedis and posterior tibial arteries are, occlusion of one of them may produce only minimal changes in temperature, color, and so forth, as the companion artery continues to carry blood to the distal parts. Our data regarding arteries and extremities involved are summarized in Table IV.

#### INTERPRETATION OF SYMPTOMS

All but one of the symptoms and findings observed in sudden arterial occlusion are of obvious origin. Pulsations are absent because the artery is occluded proximally. Coldness of the extremity is due to diminished arterial circulation. Diminution or loss of sensory perception and motor power are manifestations of ischemia of nerves.

TABLE IV—THE ARTERIES AND EXTREMITIES AFFECTED BY SUDDEN ARTERIAL OCCLUSION

Arteries in all cases		Embolism		Thrombosis	
Aorta		1	0		
Iliac		2	1		
Femoral		16	19		
Popliteal		23	1		
Posterior tibial		5	3		
Anterior tibial		0	1		
Dorsalis pedis		0	2		
Axillary		0	2		
Brachial		8	8		
Radial		0			
Ulnar		1	2		
Digital		1			

Extremities in all cases

Embolism				Thrombosis			
Arm		Leg		Arm		Leg	
Right	Left	Right	Left	Right	Left	Right	Left
6	4		7	3		3	

and muscles. The pain which supervenes when tissue is in the process of disintegration is similar to that noted in death of tissue from many causes. The symptoms of ischemic neuritis described by Goldsmith and Brown are due to degenerative changes in the nerves resulting from ischemia. The cause of the pain that appears suddenly in a severe form in many instances as the first manifestation of arterial occlusion is more difficult to explain. Why is it that slow occlusion of large arteries may occur without pain a situation well demonstrated by widespread arterial occlusion in thrombo-angitis obliterans and arteriosclerosis obliterans whereas one of the chief symptoms of sudden arterial occlusion is pain? For some time we have felt that ischemia following sudden arterial occlusion was too profound to be caused by the organic occlusion alone.

It seems unreasonable to us that sudden occlusion of the popliteal artery for example should cause gangrene in about half the cases when we frequently see individuals with chronic occlusion of the popliteal artery without any great degree of impairment of the arterial circulation. There seems to be a factor contributing to the ischemia in addition to simple interruption in the continuity of the lumen of the artery. Always when we have observed patients with sudden arterial occlusion whose pain has begun abruptly we have been dissatisfied with our explanation of the cause of the pain namely ischemia. Recently we have believed that the pain and profound ischemia were caused in a large degree by arterial spasm.

This is supported by observations by other investigators. Seifert and others have observed arterial spasm in the involved artery during the operation of embolectomy. After observation of patients with arterial embolism Seifert concluded that the severe pain was due to arterial spasm. In a study of experimentally produced embolism Gosset Bertrand and Patel observed that the embolus was fixed at the point of lodgment by arterial spasm. They observed likewise that the lowered temperature of the extremity in which a main artery had been occluded by an embolus was gradually replaced by normal warmth a few hours afterward indirect evidence that the original diminution in warmth was due to arterial spasm which relaxed in the course of a few hours to allow normal warmth to return to the extremity. Dent was so impressed by the probability that arterial spasm contributed to the diminished arterial circulation that he administered papaverine hydrochloride which is an anti spasmotic as part of the treatment of sudden arterial occlusion. The results were good. Herrmann and Reiz have shown that alternate suction and pressure applied to an extremity which has sustained sudden occlusion of the main artery results in marked improvement of the circulation. Since the procedure does not influence the occluded area itself it must act by relieving spasm and inducing a greater flow of blood through inadequately dilated collateral arteries.

The best observations on changes in temperature of the extremity following experimental ligation of the external iliac artery are reported by Mulvihill and Harvey. Following the procedure mentioned the temperature of the leg was reduced to the level of that of the room in 2 to 6 hours after a reduction of 10 to 30 degrees F. This temperature persisted for several hours then there was a gradual or rapid increase so that in an average of about 13 hours after ligation of the artery the extremity was again as warm as before the operation was performed. If sympathectomy was performed when the temperature of the foot was low there was an immediate increase in warmth to a temperature level equaling that before ligation occurred. If sympathectomy preceded ligation no decrease in temperature occurred following the last procedure. These experiments offer unequivocal evidence that the decrease in temperature following ligation is due to a vasomotor mechanism. One cannot say that this vasomotor effect is characterized by active spasm or inadequate vasodilation. This observation is of some importance as active spasm might well be associated with pain whereas it is difficult to conceive

that a passive state of inadequate dilation would be. Herein may be the explanation for varying degrees and types of pain following various types of sudden arterial closure.

Statements concerning the origin of the severe pain following arterial embolism are based to a large extent on logic rather than known facts. If we assume that the lodgment of the embolus and the severe pain occur nearly simultaneously, we know of no other mechanism than arterial spasm which effects profound ischemia to account for the distress. Seifert, who has given this phase of the problem consideration, believed this to be the case and relates two experiences to support his contention. A woman, aged 44 years, was afflicted suddenly with evidence of occlusion of the axillary artery, the pain affected the entire area from the middle of the arm distally. Five hours later the pain suddenly changed, so that it involved only the extremity, from the junction of the middle and upper thirds of the forearm distally. At operation no embolus was found in the axillary artery, amputation was necessary and the embolus was found in the cubital artery. Seifert believed the change in the location of the pain was due to a shift of the embolus to a more distal position. In the case just mentioned and in another, pain disappeared after arteriotomies, although gangrene supervened and amputation was necessary. Seifert believed that the relief of pain was due to the disappearance of spasm. He pointed out that sudden occlusion of an artery alone cannot be responsible for the pain observed in embolism, since ligation was often necessary for war injuries, yet the type of pain which occurs in arterial embolism was usually absent.

The probability that arterial spasm is responsible for the pain in embolism either directly or as a result of the ischemia it produces is so logical and fits so well with recorded observations regarding suddenness of onset, severity, and the difficulty of localizing the pain that we believe there is a distinct cause and effect relationship. Unfortunately, no observations based on direct visualization are available to indicate the extent of the spasm. However, the experimental work of Mulvihill and Harvey indicates a widespread localization below the point of occlusion, since interference with the circulation is so great that the temperature of the part is reduced to that of the room in which the experiments were performed.

#### THE COURSE OF EVENTS IN SUDDEN ARTERIAL OCCLUSION

All cases of sudden arterial occlusion have one common factor, interruption of continuity of the

arterial lumen. In many instances, particularly when pain occurs suddenly and is severe, it appears that arterial spasm is present. In other instances the collateral arteries fail to dilate adequately enough to allow survival of the limb. When pain is minimal and the diminution of the blood supply is not marked, it appears that spasm is absent and circulation through collateral arteries is adequate. If the mere occlusion of the artery plays a minimal rôle in the diminution of blood supply, why should not all extremities survive, since the experimental work of Mulvihill and Harvey, and of Gosset, Bertrand, and Patel, indicates that additional diminution of blood supply effected by spasm or inadequate dilatation of collateral arteries is temporary and corrected in a few hours? We cannot answer definitely, but we believe that ischemia effected by arterial spasm or inadequate dilatation of collateral arteries, if prolonged, produces changes in the intima of arteries and veins, which in turn produce widespread vascular thrombosis in the extremity when the spasm abates or dilatation of collateral arteries occurs. The diminution of blood flow is brought about, then, by organic changes alone, as the functional element has disappeared. It is true that venous thrombosis is an almost constant accompaniment of sudden arterial occlusion terminating unfavorably. This conception serves to emphasize the need for prompt treatment, either medical or surgical, when sudden arterial occlusion occurs, since delays may lead to extensive thrombosis.

#### PATHOLOGICAL CHANGES FOLLOWING EMBOLISM

An excellent experimental study of this subject has been presented by Gosset, Bertrand, and Patel. Animals were killed 1, 2, 3, 4, 5, 6, 7, and 8 days after embolism was produced experimentally and the arteries at the site of occlusion were studied. Septic emboli contained and were surrounded by bacteria 24 hours after embolic occlusion. The musculature of the artery was affected by hyaline degeneration, and severe inflammation was present in the adventitia. The following observations pertain only to occlusion by aseptic emboli. At the end of the first day the internal elastic lamina had lost its undulating character and the musculature had the appearance of aseptic necrosis. At the end of the second day hemorrhagic infiltration into the perivascular fatty tissue was noted in addition. Twenty-four hours later the periphery of the clot was fibrinous in nature and infiltrated with polymorphonuclear leucocytes and pigmented macrophages, the endothelium had disappeared largely, and the muscle fibers for the most part had disappeared. Subse-

TABLE V — THE FINAL RESULT OF SUDDEN  
ARTERIAL OCCLUSION

46 case 1 fibrolism extrema es	ing 57	34 cases 1 thrombosis involving 66 extrema es
G gre amputa na with 5 post per dis h d th with amputat t t		G g ne 5 amputa na with 5 post per dis h d th with amputat t t
Rec ryf D h m h lg grene 3 tes		Recovery death witho t gangrene s
Appl es t number of t em tea 11 cases t m tes 1 Residual s no far serial affe 11 case tremules 1 d		led cy m y as es

quent observations showed chiefly organization and fibrosis. These investigators believed that the changes noted were due in part to interference with nutrition of the artery as a result of its distention by the embolus.

### PROGNOSIS

The outcome in cases of sudden arterial occlusion leaves much to be desired. In our series of 57 extremities in which sudden arterial occlusion occurred as a result of embolism gangrene supervened in 26 instances or 45 per cent. In 31 of 60 extremities in which sudden arterial occlusion occurred as a result of thrombosis gangrene supervened an incidence of 50 per cent (Table V). One may say then that gangrene occurred in about half of all cases of sudden arterial occlusion. Admittedly the treatment of these patients was not the best according to our present understanding of the events which occur in sudden arterial occlusion. Our only excuse for the poor results is that the treatment was the conventional one at the time the patients were observed. More modern therapy should be productive of a much greater incidence of recovery. Denk's report of recovery in 7 of 10 cases as a result of the use of papaverine and Herrmann and Reid's report of recovery in all of 10 cases as a result of treatment with alternating positive and negative pressure indicate more logical therapy and hold out hope that the figures in our series may be greatly improved in future cases of sudden arterial occlusion.

It is of some interest that in our series the ultimate outcome could be predicted 24 hours after the onset of occlusion in about 80 per cent of cases of embolism and in only about 50 per cent of cases of thrombosis. This is as expected since thrombosis may be progressive and embolism is ordinarily a single concise event. Our data do not allow delineation of many of the factors determining prognosis. Age is important. Of pa-

tients more than 60 years of age with embolism gangrene supervened in 73 per cent and of patients more than 60 years of age with thrombosis gangrene occurred in 83 per cent. The respective figures for patients less than 60 years of age were 32 per cent and 42 per cent. This is likewise expected since older patients have less vitality and the ability of collateral circulation to develop is apparently inferior. Moreover atheromatous changes are extensive and encourage progressive thrombosis. It is our impression that when one of two companion arteries is involved the chances of recovery or of minimal degrees of gangrene are greatly increased. The condition of the patient is important. This is not definitely worthy of emphasis as far as recovery of an extremity is concerned but chiefly because of the possibility of death from other causes such as is present in cases of cardiac decompensation and because of the possibility of further embolism either to the extremities or more vital structures. It is apparent that the probabilities of survival of the patient are less when he suffers arterial embolism from a decompensated arrhythmic heart than if he sustains thrombosis resulting from arteriosclerosis. Another impression gained from our data is that thrombosis particularly that due to arteriosclerosis produces lesser areas of gangrene than embolism does. It is to be hoped that future studies will allow concise and accurate delineation of the factors important in a prophetic way.

## TREATMENT

There can be no reasonable doubt that a great many patients with sudden arterial occlusion are poorly treated. One frequently sees the extremity elevated and surrounded by hot water bottles. Both procedures are ill advised. Elevation diminishes somewhat the flow of blood to the extremity and the direct application of heat may cause burns which contribute to the difficulty. Barker has shown many times that tissue deprived of its normal supply of blood is extremely sensitive to thermal and chemical agents which are well tolerated by normal extremities. No treatment at all is better than elevating the extremity and surrounding it with hot water bottles.

It is beyond the scope of this paper to consider the surgical treatment of arterial emboli in namely embolotomy. This phase of the subject has been adequately reviewed by Danzis Allen and Pemberton. The recent papers of Herrmann and Reif Allen and MacLean and Denk emphasize that embolotomy may soon be considered an

I cases which he result was had the exclusion was 14 and irreparable damage had already been done.

Examples of companion arteries are the radial and ulnar arteries and the dorsalis pedis and posterior tibial arteries.

unnecessary procedure as excellent results may follow simpler measures

There are three important "don'ts" in the treatment of sudden arterial occlusion. Don't delay treatment for more than 2 or 3 hours, don't elevate the extremity, and don't subject it to heat which exceeds by more than a few degrees the temperature of the body. Delayed treatment means a poor prospect of recovery in those instances in which recovery would not occur spontaneously. Until the custom disappears entirely it cannot be emphasized too frequently that tissue deprived of its normal blood supply does not tolerate heat well. Hot water bottles are frequently of a temperature which exceeds 150 degrees F and will almost invariably provoke burns if allowed to come in contact with the skin. We believe that not uncommonly, recovery would have occurred if burns had not resulted from hot water bottles.

Opiates should be given immediately to control pain. The ingestion of alcoholic drinks is ordinarily of great benefit in this regard, apparently because alcohol is an antispasmodic, as shown by Brown and Cook, as well as an anodyne. The extremity should be wrapped in cotton, which can be held in place with a roller bandage, to preserve the natural warmth of the extremity. A cradle, open at one end, containing not more than one or two bulbs may be placed over the extremity. The temperature of the air about the limb should not exceed 105 degrees F. The extremity should be placed in a dependent position. When the legs are involved the head of the bed should be elevated, when the arms are involved, the patient should be in the semi-sitting position. Vasodilators should be given to relieve arterial spasm, if present. Papaverine hydrochloride, which is a vasodilator when given intravenously in amounts of  $\frac{1}{2}$  grain (0.032 gm) will produce improvement in the circulation of the limb within a few minutes if it is effective at all. Care should be taken that the solution of papaverine is physiologically active. If the first injection does not cause improvement, it is questionable that further trial with this drug will benefit the circulation. Denk, who originated this type of therapy, reported 10 cases in which patients were treated with papaverine. One failure was unexplained and two were due to the long period elapsing between the onset of embolism and treatment. Improvement in the 7 remaining cases was satisfactory. Allen and MacLean reported impressive improvement in one extremity and none in the other in a case in which the arteries of both extremities were occluded suddenly. If improvement follows use of

papaverine, the injection can be repeated whenever there is evidence of failing circulation to the extremity. The use of intermittent negative and positive pressure, as described by Herrmann and Reid, has been very successful in their hands and should be used if a machine is available. On the assumption that one of the chief requisites for a favorable outcome is the induction of collateral arteries to assume a heightened function of transportation of blood, spinal anesthesia may be tried when the lower extremities are involved, as Emmett has shown that this procedure produced maximal vasodilation. Brachial plexus block may produce similar effects in the upper extremities. General anesthesia may be used, if the condition of the patient permits, for the same reason that spinal anesthesia may be of value, as Craig and Horton have shown that general anesthesia produces maximal vasodilation. Sympathectomy likewise produces maximal vasodilation, as shown by Brown and Adson, Baldes, Herrick and Essex and is of value in sudden arterial occlusion, as shown experimentally by Mulvihill and Harvey, but ordinarily, the condition of the patient does not warrant such a major operation. If the procedures outlined, exclusive of sympathectomy, do not produce a rapid improvement in the circulation, surgical removal of the clot should be considered when occlusion is due to an embolus. As in the treatment of diabetic coma, constant attendance of a physician is required until the situation is relieved or the unfortunate outcome is definitely established. This duty cannot be delegated to nurses or relatives judiciously. If the diagnosis is made promptly and the treatment outlined is carried out with celerity and constant attention, we believe the results will be much better than they are when less rational, or haphazard, regimens are carried out.

#### SUMMARY AND CONCLUSIONS

An etiological classification of sudden arterial occlusion is presented, and a study has been made of data gained from the records of 100 cases of sudden arterial occlusion.

The symptoms of sudden arterial occlusion are extremely variable and multiple. The common conception that severe pain ensuing suddenly is the chief manifestation of sudden arterial occlusion is not supported by our data. Arterial spasm or failure of collateral arteries to assume a maximal function at a high level appears of paramount importance in effecting ischemia in sudden arterial occlusion.

The incidence of gangrene in our series of cases was approximately 50 per cent. We believe this

to be a lamentable record although it was compatible with our knowledge of sudden arterial occlusion at the time the patients were observed.

Treatment at the present has two objects: avoidance of procedures which do harm and relief of arterial spasm or the induction of collateral arteries to function at a higher level.

It appears that in the future treatment of sudden arterial occlusion based on our knowledge of the physiological disturbances associated with it will be productive of better results.

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D R L I S J I N S E N , M D , N e w Y o r k , N e w Y o r k  
J u n i o r P h y s i c i a n , C o l u m b i a U n i v e r s i t y H o s p i t a l

In Table III is noted the previous surgery done on these cases. The various procedures and the

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TABLE I—AGE DISTRIBUTION

	W m Hosp al case	B New Hosp al cases
1 to 13	4	12
13 to 20	89	63
20 to 30	74	43
30 to 40	17	13
40 to 50	3	0
50 to 56		

TABLE II—IMPORTANT POINTS IN HISTORY OF PATIENT

	W m Hosp al case	B New Hosp al cases
Pre us p l c d s e	27	12
P tabortal	5	8
Postp t m	7	7
Gonococci h tory	52	39
Lacer t n of the cervix	38	22
Lacer t n of the perineum	4	0
La tion f th perineum		0
St m pe sary worn		0
Symptoms fter insufflation		
Symptoms aft il ublat n		

TABLE III—SURGERY DONE PRIOR TO ADMISSION TO THE HOSPITAL

	W m Hosp al case	B New Hosp al cases
P st mor c l pot my for bsc	8	3
Dilat n and cu rit ge	35	
R m l f net be and o ary		
H y t rectomy with em l f n t be	1	1
and o ary	7	3
Abd minal pe t n f r p l c ab ss	3	3
R p r of perineum	1	3
Suspension of the ut r		
Cesare n section	5	7
Myom tomy	0	1
Appendicit my		
Cer cal bsc s		
Pe to tis		
Abscess f th lab a		0
Hem h dectomy		
R tal fissure		

cent intestinal coils may become matted together. Infrequently an intestinal obstruction will follow. Menge reports 2 cases of pelvic abscess perforating the rectum produced by postmortem which showed ulceration of the outer coat toward the lumen.

Abscesses which follow abortions postpartum abscesses and those secondary to lacerations of the cervix or perineum are essentially found in sections and spread by way of the lymphatics and blood vessels. These are caused chiefly by the streptococcus and staphylococcus. When the resistance of the host is high the infection becomes limited to the subperitoneal connective tissue in which either the exudate is absorbed or large collections of frank pus are formed. Spontaneous rupture of these abscesses may take place into the adjacent viscera or the peritoneal cavity rarely into the urinary bladder. The latter complication occurs only in severe types of infection usually localized in the utero-vesical space or anteriorly in the space of Retzius.

## SYMPTOM

The largest number of cases occur in the third and fourth decades. Table I shows the age distribution. On analysis of the entire series the most common symptom was found to be pain absent in only 1 case. The location and distribution of this symptom varies widely. Most frequently it is referred to the lower abdomen and coming on more gradually than suddenly. It was usually described as an intensely severe ache rather than sharp and knife like in character. It was usually referred to the lower abdomen and in this location was generally bilateral. Many also had pain elsewhere as noted in Table IV. The pain was usually referred to the site of the exudate. If the

pathology they attempt to remove leave tissue changes which predispose to renewed infection by reducing the local resistance to invading bacteria. Then by direct introduction of gonococci or of other pathogenic bacteria as in induced abortion the inflammatory process extends relatively rapidly. Furthermore it is well known that pathogenic organisms can remain quiescent in the tissues until resistance is lowered by local trauma or systemic disease with the consequent development of a suppurative process.

Some of the causes of pelvic abscess can be eliminated. Lacerations of the cervix or perineum should be promptly repaired. The application of stem pessaries should be avoided. Intra uterine insufflation of air or iodized oil should be done only in the absence of an inflammatory process. The practice of abortion can be eliminated only through the education and evolution of the human race.

The type of pathology in these various infections depends on the organism. The most congenial habitat of the gonococcus is a moist mucous surface. It has no predilection for the subperitoneal connective tissue although it may involve these areas. With involvement of the tubal mucosa the tissue becomes edematous diminishing the blood supply. The front line of defense breaks down and ulceration of the mucosa takes place. As the exudate collects it distends the necrotic walls of the tube and spontaneous rupture of the tubal abscess may take place into the adjacent viscera or the peritoneal cavity itself. More often a plastic exudate forms rapidly enough on the surrounding peritoneal surface to avoid these complications. Because of this plastic exudate adja

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TABLE IV—PAIN

	Woman's Hospital series	Bellevue Hospital series
Both lower quadrants	129	65
Right lower quadrant	25	37
Left lower quadrant	42	35
Lower back	60	19
Right thigh	11	5
Left thigh	8	-
Rectum	27	4
Vagina	5	-
Urethra	1	0
On defecation	13	8
In buttocks	0	1
Shoulders	0	0
No pain	1	0

TABLE V—URINARY SYMPTOMS

	Woman's Hospital series	Bellevue Hospital series
Dysuria	65	37
Frequency	39	--
Nocturia	29	15
Urgency	14	3
Retention	9	9
Incontinence	1	1
Bloody urine	2	-
Relief of pain by micturition	1	1

TABLE VI—OTHER SYMPTOMS

	Woman's Hospital series	Bellevue Hospital series
Vaginal bleeding	46	32
Profuse vaginal discharge	42	18
Bleeding from the rectum	1	1
Beginning of symptoms at menstruation	2	4
Diarrhea	3	1
Fainting spells	3	1
Chills	3	1
Nausea and vomiting	3	1
Sweating	3	1
Bloody vomitus	3	1
Beginning of symptoms with influenza	3	1
Beginning of symptoms with acute pharyngitis	3	1

TABLE VII—PRESENCE OF MASS ON EXAMINATION

	Woman's Hospital series	Bellevue Hospital series
Above the symphysis	31	21
Right lower quadrant	15	11
Left lower quadrant	23	14
Both fornices and cul-de sac	67	51
Right fornix	40	17
Left fornix	47	21
Cul de sac only	41	35

collection was low, it was referred to the external genitals, if the lateral side of the pelvis was involved, it extended down one or the other leg. One patient in the entire series complained of pain on one side of the abdomen when the mass of exudate was located on the opposite side of the pelvis. An important aid in the localization of the abscess was the presence of persistent tenderness after the pain had abated.

Urinary disturbance of one type or another was commonly present. This is shown in Table V. On analysis dysuria was shown to be the most frequently present. Vaginal bleeding, often present, was an important point in differential diagnosis, particularly with pain on the right side. Chills, fever, and sweats were common with the accompanying disturbance of the gastro-intestinal tract such as nausea and vomiting. Profuse vaginal discharge was frequently present. Occasionally the symptoms dated from the previous menstrual period. Less frequent symptoms are noted in Table VI.

Examination always revealed tenderness in the lower abdomen often bilateral, and less frequently localized to one or the other lower quadrants. Commonly a mass was present in one or the other iliac fossa or, at times, above the symphysis. Rigidity of the lower abdominal muscles was not a frequent finding, present only in 15 per cent of the cases. This is especially important in lesions on

the right side which may be confused with inflammation of the appendix.

The blood count was usually high although it showed great variability. The lowest count in this series was 3,400 white blood cells with 82 per cent polymorphonuclears. The highest count was 76,000 white blood cells with 94 per cent polymorphonuclears and the average count was 17,600 white blood cells with 88 per cent polymorphonuclears. The temperature was relatively high, the average rise being 102.4 degrees F and the average pulse rate varied between 90 to 110.

With rare exceptions a mass was palpated on pelvic examination either unilateral or bilateral occasionally filling the entire pelvis. This is shown in Table VII. Frequently the mass was palpable through the abdomen only. Not infrequently multiple abscesses, more or less coalescing, were present.

## TREATMENT (5, 6, 14, 19, 24, 32)

In 1879 Emmett emphasizing Brucell's said, 'the rule is as applicable here (in cases of pelvic abscess) as in general surgery, to open freely a collection of pus as soon as it can be detected.' It required courage and daring as well as common sense to advocate such procedures openly more than 50 years ago.

In this series of 328 cases there were 32 cases at Bellevue and 2 in the Woman's Hospital group treated without operation in which sterile milk injections, the Elliott treatment (18) hot douches, rest in bed and general supportive measures were used. There were no deaths in this group. Six of these patients were readmitted from 15 days to 3 years later. Of these in 2 posterior colpotomy in 3 abdominal operations for collections of pus were performed. One was treated conservatively. One death occurred after operation.

Of those treated by primary operation posterior colpotomy was the procedure of choice. In the Bellevue group this was carried out 94 times and in the Woman's Hospital 165 times. The next most frequent procedure was abdominal incision, excision of the abscess walls and structures involved, closure of the incision and drainage by a colpotomy opening. This was done in 49 cases at the Woman's Hospital and in 15 at Bellevue except that in this group drainage was established through the abdominal incision with no opening in the vaginal fornices. In 2 additional cases in the Woman's Hospital which proved to be suppurative appendicitis abdominal drainage only was employed. In the entire series of 328 cases in 8 laparotomy with drainage through both the abdominal incision and posterior colpotomy was done. In 3 of these 8 cases spontaneous rupture of the abscess into the peritoneal cavity had taken place. In 5 the abscess wall was accidentally ruptured during operation. In this latter group in addition the lesions of an active peritonitis were present. In 4 cases at Bellevue the abscess was opened extraperitoneally above Poupart's Ligament. Five cases of the total series were drained by anterior colpotomy. In 1 of these the urinary bladder was opened which resulted in a vesicovaginal fistula. In 9 of the 328 cases laparotomy and complete closure without drainage was done. In 2 of these cases drainage by posterior colpotomy was subsequently necessary. In 3 the entire abscess wall was removed without soiling or spilling of the pus and in 1 in the absence of pus the operation was performed in order to separate the adhesions.

On a total of 294 patients there were 373 operations performed. Supplementing the procedures there were frequent intramuscular injections of sterile milk; this was done at the Woman's Hospital in 61 cases and at Bellevue in 6. The Elliott treatment was also used in 7 cases of the series without apparent benefit although the small number prevents any definite conclusions as to the value of this type of treatment in pelvic abscess.

Wharton in an extensive summary of 716 cases of pelvic abscess stated that irrigation of the abscess cavity was discontinued because it did not benefit the patient and with suspicious frequency was a factor in producing peritonitis. Of the total series irrigation of the colpotomy tract was carried out in 20 patients without apparent benefit or noticeable harm. Saline, boric acid and potassium permanganate solutions were used. The average stay in the hospital in the various groups was 32 days with the tract irrigated and 24 days when the tract was not irrigated. With supplemental sterile milk injection an average stay of 44 days was noted and in the absence of milk injections a stay of 2 days. However this does not accurately reflect the severity of the infection or the patient's resistance to the infection.

Cullen stated under no circumstances open up Douglas pouch in postpuerperal broad ligament infections; it is almost criminal advocating drainage extraperitoneally above Poupart's ligament. On the contrary the site of the abscess should govern the location of the incision for the evacuation of the pus that accordingly colpotomy is indicated in abscesses extending toward the vaginal fornices while laparotomy should be performed for abscesses approaching the anterior abdominal wall. The treatment advocated provides drainage that is adequate and still with minimum shock to the patient.

Summarizing the mortality based on the operative procedure the following figures are noted in the Woman's Hospital: drainage of the abscess other than by laparotomy was done 165 times with 4 deaths, a rate of 2.36 per cent and the abdomen was opened alone and in conjunction with other measures 80 times with 7 deaths or 8.78 per cent. In Bellevue Hospital drainage by other measures than by abdominal incision was done 100 times with 3 deaths or 3 per cent and laparotomy was carried out 10 times with 4 deaths or a rate of 40 per cent. These figures do not indicate the severity of the infection or the patient's resistance but they are of value in further emphasizing the benefit of simple drainage whenever feasible to the life of the patient.

Exceptionally after drainage only by colpotomy or laparotomy has been carried out a second operation is necessary to remove the thickened walls of an abscess cavity or a localized collection of pus or to separate adhesions or to correct distortion of the pelvic structures through the contraction of scar tissue. However this should be postponed until the condition of the patient warrants it. Frequently the signs of previous infection disappear altogether.

TABLE VIII—COMPLICATIONS GROUP I

	Woman's Hospital series	Bellevue Hospital series
Spontaneous rupture into peritoneal cavity		
Postpartum and postabortal	1	1
Tubo-ovarian	2	2
Spontaneous rupture into rectum		
Postpartum and postabortal	3	2
Tubo ovarian	3	4
Spontaneous rupture into vagina		
Postpartum and postabortal	1	3
Tubo ovarian	2	3
Spontaneous opening into sigmoid	1	1
Spontaneous fecal fistula of urinary bladder	1	0
Spontaneous drainage of abscess through uterus and cervix	1	0

## COMPLICATIONS (16, 21)

The complications are classified into three groups first, those due to local extension of the disease as enumerated in Table VIII, second, accidents in the course of the operative procedure, as noted in Table IX, and third those which develop in some remote organ or structure as listed in Table X.

In the first group are included those patients in whom the abscess spontaneously ruptures into adjacent organs or into the peritoneal cavity. The latter complication is unusual but by no means rare. Bonney reported 20 recorded in the literature up to 1909 and added 1 of his own. Others had doubtless occurred but had never been reported. More recently the cases recorded have been quite numerous (3, 4, 11, 15, 29, 32). In the entire series there were 6 cases with spontaneous rupture of the abscess into the peritoneal cavity. These cases were drained by both the abdominal incision and posterior colpotomy, and 3 deaths occurred, on the operative, first, and second post-operative day from general peritonitis. In 9 cases in the series spontaneous rupture into the vagina occurred with no deaths. There were 12 patients with spontaneous rupture into the rectum with 1 death.

One case in the Bellevue series developed a fecal fistula after abdominal operation in which accidental tear of the intestine was the cause. In the Woman's Hospital group, the rectum was accidentally opened during operation in 4 cases. In another case a fistula of the bladder developed (10, 13), permitting the passage of fecal material into that viscus. This was demonstrated by the recovery of fecal material when the bladder was irrigated. This fistula closed without operation in one month. In 1 case in the series, the abscess spontaneously drained through the uterus and

TABLE IX—COMPLICATIONS GROUP 2

	Woman's Hospital series	Bellevue Hospital series
Abscess secondary of the abdominal wall including one of tuberculosis origin	4	1
Accidental opening of rectum at operation	4	1
Accidental opening of urinary bladder at operation	1	0
Accidental opening of sigmoid at operation	2	0
Vesicovaginal fistula	1	0
Intestinal obstruction	1	0

TABLE X—COMPLICATIONS GROUP 3

	Woman's Hospital series	Bellevue Hospital series
Thrombophlebitis	1	1
Pyelitis	2	0
Diverticulitis	1	0
Parotitis	0	1
Pulmonary embolus	1	0
Bronchopneumonia	0	1
Pulmonary abscess	1	0
Empyema	1	0
Pulmonary tuberculosis	1	0
Osteomyelitis	0	1
Abscess of the buttocks	0	1
Effusion of the shoulder	0	1

cervix (16). In 1 case in which the abscess localized in the uterovesical space, was drained through an anterior colpotomy, the bladder was found to be opened. This was considered an accidental perforation and resulted in a vesicovaginal fistula.

In the Woman's Hospital series 4 cases developed a secondary abscess of the abdominal wall following laparotomy. In these cases there was complete closure of the abdominal incision. In one of these cases of mural abscess the granulation tissue proved to be tuberculous upon microscopic examination. The condition healed within 6 weeks. In the Bellevue group 1 case developed a secondary abscess of the abdominal wall following drainage but healed rapidly after incision and drainage.

It is of interest to note the rarity of intestinal obstruction in pelvic abscess. Why it does not occur more often is difficult to understand when one realizes that the intestinal coils are frequently matted together with the plastic peritoneal exudate which forms on the serosa surrounding the inflammatory mass. This complication occurred in 1 case in the entire series, readily relieved by enterostomy, the patient recovering.

Spontaneous opening into the sigmoid is uncommon in this series. This opening will usually close itself without operative procedure if given



general sepsis, and the third the one hundredth and fortieth postoperative day of chronic sepsis. Of the 4 which followed laparotomy, 2 occurred the first postoperative day, 1 of general peritonitis and sepsis, and 1 of pneumonia, general peritonitis and septicemia. A postmortem examination was done on this case which revealed in addition, a septic endometritis and a subphrenic abscess. In the third and fourth cases the patients died on the fourteenth and thirty-third postoperative day, respectively, of chronic sepsis. Reviewing these deaths and their causes, it appears that the patient succumbed to the infection rather than the operative procedure, although the influence of the latter in contributing to the fatal result, depending on the length and extensiveness of the operation performed, must always be an important factor. It seems true, however, that in those cases succumbing after the second or third postoperative days, the cause of death was primarily the infection with the operative procedure playing little or no part.

There has been no reduction in the mortality rate in the last 40 years, despite the use of diathermia and the injection of foreign protein. Nor have the many other measures of modern treatment reduced the rate. This point is worthy of emphasis, as too often a particular procedure is given too much credit for the cure effected. These cases were all observed and treated by skillful surgeons of wide experience in their field. In some cases operations seemed to be unduly extensive or done too early. Nature should always be given sufficient time to restrict the infection to the pelvic cavity.

It is the writer's belief that the evacuation of pus and serum at its most accessible point should be the primary aim in this condition, and that the removal of the wall of the abscess should be deferred until such time as the condition of the patient warrants it. Anterior colpotomy even in the most expert hands occasionally results in perforation of the bladder and, therefore, for general use should be avoided. Lower abdominal incision and drainage extraperitoneally when the abscess is located anterior in the uterovesical space or forward in the space of Retzius can be done with relatively little shock to the patient and with less danger of injury to the urinary bladder.

Generalizations on surgical procedure are dangerous and in the last analysis the individual case must be treated according to location and type of pathology found.

#### CONCLUSIONS

1. A study of 328 cases of pelvic abscess in women is presented.

2. A brief history of the present concept of the disease and its treatment is discussed.

3. Causative factors in the disease and suggestive measures for prevention are outlined.

4. The pathology of the disease varies according to the type of offending organism, although frequently the extent of the process is not limited to any one structure.

5. The common symptoms and signs and those less often present are enumerated.

6. The results of treatment are variable, but in general, the more conservative the measures the less the morbidity.

7. The complications are varied, and except in the occasional instance, respond to conservative treatment.

8. The more extensive the operative interference the higher the mortality figures.

9. Despite the present use of diathermia, injections of foreign protein, and other innovations of modern treatment, the mortality figures in the last 40 years have not been lowered.

I wish to thank Dr. George Gray Ward, chief surgeon of the Woman's Hospital, and Dr. William E. Studdiford, Jr., chief of the Service at Bellevue, for their kind permission to review the records of their respective services.

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# SURGERY GYNECOLOGY AND OBSTETRICS

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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1935-1935

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AUGUST, 1935

### DEHYDRATION

MANY adaptations have taken place in the cell since animal life arose from the primordial swamps but existence still depends upon a more or less continuous supply of water to the organism. Man is still a sea animal but now carries his own bit of ocean with him, protected from evaporation by his covering integument.

The relationship of body stores of food to that of fluid was brought out by Rubner when he demonstrated that a starving animal can lose practically all its glycogen fat and half of its body protein to approximately 10 per cent of its body weight and still live whereas the loss of scarcely 10 per cent of its water content results in serious consequences, while the loss of from about 20 per cent results in death. Dehydration may develop in man most simply by deprivation of food and water. The body has no mechanism for the formation of considerable quantities of water and water

continues to be lost from the two main excretory processes: the one concerned in the removal of waste products through the kidneys, the other devoted to dissipating heat in controlling body temperature by evaporation from the skin and lungs. The negative balance for the day of about 1 liter is offset by water withdrawn from the body fluids, chiefly from the interstitial stores in the muscles and subcutaneous tissue. This fluid is given up with increasing reluctance since the retention of materials originally held in solution results in an increased concentration of those substances, a condition poorly tolerated by the body and demanding water for its correction. The time quickly arrives when it is more important for the organism to keep what water it has than to furnish water for the kidneys and for the dissipation of heat and as a result, anuria, a hot dry skin, sunken eyes, and fever develop. Some water continues to be lost from the skin and lungs, dehydration increases and delirium and coma supervene before death.

In disease, dehydration occurs commonly since along with the inability to ingest water and food, many other factors increase the depletion of water. Fever increases the amount of water vaporized from the skin and lungs while vomiting, diarrhea and drainage from intestinal or biliary fistulas may carry away large amounts of fluid from the gastro-intestinal tract. The severe dehydration associated with diabetic coma results from vomiting, pulmonary hyperventilation, and the diuresis from glycosuria and ketosis. In burns, the massive exudation of fluids into and from the inflamed tissues, depletes the body fluids to an extraordinary degree. The paramount

importance of fluids to such patients is well known. Few surgeons fail to recognize the signs of dehydration when they exist at the time a patient is first examined. The only question is how much and what kind of fluid should be given in the next 24 hours to restore water balance. The quantitative problem can be solved by providing water needed for excretion during this period with an additional amount to be retained to relieve the dehydration. Studies have shown that in the sick surgical patient it is well to allow 1500 cubic centimeters of water daily for urine and 2000 cubic centimeters for vaporization of water from the skin and lungs. Facts have been obtained which aid in estimating the amount of fluids previously lost with dehydration.

When water is withheld from normal humans the signs of serious dehydration—scanty urine, a dry skin and tongue, sunken eyes—appear when the body has lost fluid amounting to approximately 6 per cent of the total body weight. This figure is about the same as Rubner's figure of 10 per cent of the water content since the body is about 65 per cent water. The actual amount of fluid lost in producing serious symptoms will vary greatly with the size of the individual; thus 6 per cent of an adult of 80 kilograms (176 pounds) is 4800 cubic centimeters while that of an infant of 5 kilograms (11 pounds) is only 300 cubic centimeters. The smaller the individual the less is the fluid reserve and the easier dehydration occurs.

The dehydrated patient will then require in the first 24 hours of treatment the 3500 cubic centimeters previously mentioned for the urine and vaporization of water from skin and lungs and an additional amount approximating 6 per cent of his body weight making a total for man weighing 80 kilograms of 8300 cubic centimeters. It is obvious that the usual 2 to 3 liters are entirely inadequate. If these

insufficient amounts are given some water will be vaporized while most of the remainder will go to the depleted body stores while the oliguria will continue. It is only when the preferential process that is water for the control of body temperature and for the restoration of body fluids has been satisfied that water becomes available for the kidneys.

Dehydration sometimes develops in the face of what superficially seems to be an adequate intake of water and requires a greater consciousness of water balance for its recognition. The fact that 3 to 4 liters of fluid are being given daily diverts the surgeon's mind from considering depleted body fluid as the possible cause of an insufficient output of urine. The patient may have some urinary tract lesion which appears to be the cause of the renal insufficiency. I frequently in such instances check up on water exchange of the few previous days allowing 2000 cubic centimeters daily for water vaporized and adding up all abnormal losses such as vomitus will show a negative balance to be responsible for the oliguria. With a greater fluid intake the urine volume increases to a satisfactory amount. A single experience such as this keeps one eternally on the alert.

The kind of fluid to be given to the dehydrated patient also merits consideration. This depends on the substance lost with the water. In dehydration due simply to a failure to drink, substances such as sodium chloride and nitrogenous waste materials are concentrated in the body and water alone is needed to relieve the situation. This can be supplied parenterally by the use of 5 per cent dextrose in distilled water, the dextrose being rapidly oxidized and the water left for body needs. The administration of salt solution in such a case would simply complicate the situation. Dehydration in surgical patients is commonly the result of a loss of fluid from the gastro

intestinal tract, usually by vomiting. The loss of sodium and chloride ions, the chief electrolytes in vascular and interstitial fluid, may be appreciable in such instances and as has been shown, require replacement along with water to restore body chemistry to normal. When such losses are known or suspected one may estimate, by determining the blood chlorides and the carbon dioxide combining power, the extent of such derangements. If these findings are low, a saline solution should be given until the electrolyte loss has been corrected as shown by blood chemistry studies repeated within 2 days at least. Since there is always a tendency for edema to develop with an excess of sodium solution saline solution should be given only when there is a definite indication for its use.

Water is best given by mouth, but if this is impossible it may be given by parenteral methods. These are tiresome for the patient and not without their dangers, therefore there is every reason why this form of therapy should be placed on a simple qualitative and quantitative basis. FREDERICK A. COLLIER

### THE PAIN-MECHANISM IN BILIARY DISEASE

THE pain of biliary colic has been recognized as being obstructive in type, such obstructions occurring in the gall bladder and in and about the common bile duct. Continuation of a similar type of pain subsequent to cholecystectomy has led to speculation as to its cause. Not infrequently recurrence of pain is the result of (1) stones in the common bile duct, particularly the small, overlooked stone in the ampulla which does not produce jaundice, (2) recurring pancreatitis associated with cholangitis, and (3) partial stenosis or inflammation in the region of the sphincter of Oddi. The persistence of pancreatitis, with narrowing of the common

bile duct subsequent to operation on the biliary tract, has been demonstrated roentgenologically by Mirizzi,<sup>1</sup> by Walters and Thiessen<sup>2</sup> and by Hicken, Best, and Hunt.<sup>3</sup>

In several cases studied by Walters and Thiessen, reflux of the opaque substance into the pancreatic duct has been clearly demonstrated. Whether or not this reflux results from malfunction of the sphincter of Oddi, and in one of the etiological factors in producing pancreatitis and attacks of colic, seems worthy of investigation.

Recent work by Butsch and McGowan<sup>4,5</sup> of the Mayo Foundation, in which they studied and recorded pressure within the common bile duct, has thrown considerable light on the problem. These investigators have shown that the normal pressure of zero existing within the common bile duct can be increased from 150 to 300 millimeters of water after administration of morphine. This rise in intraductal pressure they have demonstrated graphically by means of the kymograph. Pain similar to that described as biliary colic is experienced by the patient whose intraductal pressure is increased. Almost immediate relief from the pain is obtained with reduction in the intraductal pressure by sublingual administration of 1/100 grain (0.0006 gm) of nitroglycerin or by inhalation of the content of a glass ampule of amyl nitrite. If the duct is filled by a substance (brominol) which is opaque to the roentgen rays, rather than by water, the contour of the common and hepatic ducts can be observed fluoroscopically. With the increase in

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intraductal pressure produced by morphine fluoroscopy and roentgenographic examination give evidence of marked filling of the intrahepatic ducts and of abrupt termination of the column of opaque substance in the region of the sphincter of Oddi. This was not true in the case of the controls in which the emptying mechanism of the duct had not been interfered with by the administration of morphine.

These results have led to a contribution to the therapeutics of the postoperative period. The so called biliary colic of several patients who have had attacks of pain following cholecystectomy has been controlled by administration of nitroglycerin or amyl nitrite. The sudden and complete relief of pain has been

startling to some of the patients who had been given morphine on other occasions. The practical value of such studies is apparent but of equal importance is the fact that the methods used by Butsch and McGowan make it possible to study in detail the emptying mechanism of the common and hepatic bile ducts with particular reference to the lower end of the common duct and the sphincter of Oddi.

Whether the increase in intraductal pressure which produces the biliary colic is attributable to (1) malfunction of the sphincter of Oddi or (2) to spasm of the intraduodenal portion of the common bile duct the result of increased duodenal peristalsis are problems for continued study. WALTERMAN WALTERS





*Ernest Hemingway*



years Most of his time was spent in Wurttemberg Berlin Heidelberg and Vienna with visits to England and France Returning home he soon moved to Portland and established himself as a general surgeon with special attention to industrial and orthopedic surgery

In 1917 Dr Sommer was commissioned Captain in the Medical Corps of the U S A and was first stationed at Camp Lewis where for several months he acted as autopsy surgeon This service he enjoyed immensely and he never tired of relating his experiences Just before the Armistice he was sent to Camp Crane Allentown Pa where he was placed in charge of surgical service at Base Hospital 103 He was early released from the Army returned home and was appointed *director general of the influenza epidemic in Portland* Later he returned to private practice In 1919 he was appointed chief surgeon of the Portland Railway Light and Power Company which position he held at the time of his death Dr Sommer was a charter member of the American College of Surgeons vice president in 1924-25 and member of the Board of Regents in 1928-1933 He was active in the state medical society and the county society He was a charter member of the Pacific Coast Surgical Society and its president in 1933 also a member of the Portland Academy of Medicine and of the North Pacific Surgical Society He had been clinical professor of surgery in the University of Oregon Medical School and had conducted his clinics at St Vincent's Hospital For several years he was a member and later became chairman of the board of governors at this institution During his active career he published few papers but at the Society meetings he took a very active part in the discussions Here his knowledge and reading gave him advantage over most of his associates His talks were often of more value and listened to more attentively than the essays which were read

Dr Sommer was profoundly interested in his profession and was active engaged in its practice for over forty years He was always a student constantly endeavoring to increase his knowledge and to improve his technique He impatient in his treatment of ham hypocrisy and pretense but in the of real suffering he was the personification of tenderness and sympathy He quick to anger and because of this trait (never fully overcome) unfortunate gave offense to many of his friends In making amends his native diffidence caused him extreme distress and embarrassment

During his later years he was increasingly interested in promoting the welfare and increasing the scientific knowledge of deserving youths in his profession it was extremely gratifying to him to note the progress of some of his several of whom have made truly remarkable records

Dr Sommer retired from active practice in 1931 following a cerebral accident Since that time he has resided at his lodge at Cannon Beach coast of Oregon At the time of his retirement he donated his entire library



University of Oregon Medical School, this library being known as the "Ernst A Sommer Unit of the University of Oregon Medical School Library "

He was interested in all outdoor sports but, with the exception of fishing and golf, took very little active part in them. A master in his home, a very human individual, one with faults and frailties, but with luminously fine qualities too, of him it can be said that

"the elements  
So mix'd in him that Nature might stand up  
And say to all the world 'This was a man!'"

He passed away on March 15, 1936

T M JOYCE



# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

DONALD C BALFOUR, Rochester, *President*

EUGENE H POOL, New York, *President-Elect*

HENRY P BROWN, JR, *Chairman*, GILSON C ENGEL, *Secretary, Committee on Arrangements*

## PRELIMINARY PROGRAM FOR THE 1936 CLINICAL CONGRESS

THE Committee on Arrangements for the 1936 Clinical Congress of the American College of Surgeons to be held in Philadelphia, October 19-23, is planning largely for the clinical entertainment of Fellows of the College and their guests. A program of surgical clinics and demonstrations will be presented that will provide a complete showing of the clinical activities in all departments of surgery in that great medical center. The Committee is assured of the hearty co-operation of the clinicians at the five medical schools and more than thirty hospitals participating in the clinical program.

A preliminary schedule of the clinics and demonstrations appears in the following pages. Published in tentative form at this time and incomplete in some respects, the clinical program is to be revised and amplified during the coming months as the work of the program committee progresses. Operative clinics and demonstrations in the hospitals are scheduled for the afternoon of Monday, October 19, beginning at 2 o'clock and for the mornings and afternoons of each of the four following days. The real program of the Congress will be published from day to day, a complete and accurately detailed program being posted in the form of bulletins at headquarters each afternoon for the succeeding day and issued in printed form the following morning.

The committee expects to develop many special features in the clinical program including (1) Cancer clinics demonstrating the treatment of cancer by surgery, radium and x-ray, (2) fracture clinics presenting modern methods in the treatment of fractures, (3) clinics in traumatic surgery presenting the newer methods of rehabilitation of the injured by surgery and physical therapy.

A number of distinguished surgeons from foreign countries will attend the Congress in Philadelphia including the following:

Sir James Walton, London, England, William F Shaw, Manchester, England, Archibald H McIndoe, London, England, J P Lockhart-Mummery, London, England, Alexander MacLennan, Glasgow, Scotland, Josef Halban, Vienna, Austria, Paul Clairmont, Zurich, Switzerland, Martin Kirschner, Heidelberg, Germany, Wolfgang Rosenthal, Leipzig, Germany, F Sauerbruch, Berlin, Germany, and Rodolfo E Pasman, Buenos Aires, Argentina.

Of particular interest to those who specialize in surgery of the eye, ear, nose and throat is the extensive schedule of operative clinics and demonstrations at the hospitals prepared by the subcommittee on ophthalmology and otolaryngology presented in the following pages.

Otolaryngologists present at the Clinical Congress are invited to attend a meeting of the Section on Otology of the College of Physicians of Philadelphia at the College building at 19 S 22nd Street on Wednesday evening at 8 30. Dr Wells P Eagleton, of Newark, New Jersey, will deliver an address on "Certain Aspects of Surgical Meningitis." A subscription dinner, preceding the meeting, will be held at the Rittenhouse Hotel at 6 45.

### EVENING MEETINGS

Programs for the five evening sessions, as prepared by the Executive Committee of the Board of Regents, are presented in the following pages. All are to be held in Irvine Hall. At the presidential meeting on Monday evening the retiring president, Dr Donald C Balfour, of Rochester, will deliver an address followed by the inauguration of the new officers: Dr Eugene H Pool, New York, president, Dr Emile F Holman, San Francisco, first vice-president, Dr George E Wilson, Toronto, second vice-president. The annual oration on surgery will be delivered by Sir James

Walton of London surgeon to the King's household and attending surgeon at London Hospital.

The papers to be read at the sessions on Tuesday, Wednesday and Thursday evenings by eminent surgeons of the United States, Canada and foreign countries deal with surgical subjects of present day interest.

Also the Executive Committee of the Board is preparing programs for scientific sessions on Tuesday and Thursday evening at which outstanding ophthalmologists and otolaryngologists of the United States and Canada have been invited to present and discuss papers of timely importance and interest in these special fields of surgery.

The 1936 class of initiates will be received into Fellowship at the Convocation on Friday evening on which occasion Dr. Eugene H. Pool will deliver the presidential address.

#### SPECIAL FEATURES OF THE PROGRAM

Special features of the program for this year's Congress include: (1) A conference on fractures under the auspices of the Committee on Fractures; (2) a symposium on cancer arranged by the Committee on the Treatment of Malignant Diseases; (3) a conference on cancer clinics; (4) a conference on industrial medicine and traumatic surgery under the auspices of the Committee on Industrial Medicine and Traumatic Surgery.

The showing of surgical motion pictures demonstrating clinical features of interest has met with popular acceptance in recent years and will be continued at this year's Congress with an enlarged program of films both sound and silent to be exhibited daily at headquarters.

In recognition of an obligation to the public to provide authoritative information on modern surgery, better hospitals and the prevention of disease, a community health meeting will be held on Wednesday evening under the auspices of the College in the Municipal Auditorium.

#### FRACTURE SYMPOSIUM

Under the auspices of the Committee on Fractures a symposium on fractures will be presented in the Rose Garden on Tuesday afternoon including papers as follow:

FREDERICK W. BAKER, M.D., New York, Chairman  
Committee on Fractures  
Facts of the Fracture End of the Fracture New Method  
of Fracture with the table of the Fracture  
T. MOORE, M.D., Columbus, Ohio  
Fracture Dislocation of the Cervical Vertebrae  
FRANK M. DUNN, M.D., New York  
Facts of the Fracture of the Lumbar Vertebrae  
THOMAS M. DUNN, M.D., New York

Future Work of the Association of American Railroad  
ROSCOE C. WEBB, M.D., New York  
Facts of the Foot (except the Os Calcis)  
THOMAS M. DUNN, M.D., New York  
M.D. Heidelberg, Germany

#### CANCER SYMPOSIUM

On Friday afternoon in the Rose Garden a symposium on cancer will be presented under the auspices of the Committee on the Treatment of Malignant Diseases. Papers will be presented as follows:

CHARLES A. DUKES, M.D., Oakland, Chairman  
Committee on the Treatment of Malignant Diseases  
An Occasional Study of the Cancer of the Esophagus  
L. E. M.D., Ann Arbor, Michigan  
Malignant Tumors of the Lymphatic System  
Radical Operations in Cancer of the Prostate Gland  
YOUNG, M.D., Baltimore  
Benjamin S. C. M.D., LEANEST, M.D., CODMAN, M.D., B. I.  
Topical treatment of J. P. LOCKHART, M.D., MUMFORD, M.D.  
B. CH. F. R. C. S., London, England  
Topic to be announced: ALEXANDER MACLEOD, M.D., M.D.  
C. M. L. M. Glasgow, Scotland

#### CONFERENCE ON CANCER CLINICS

On Thursday afternoon following the annual meeting of the Fellows a panel discussion on cancer clinics will be held in the Rose Garden. Specific phases of organization and administration adapted to meet conditions encountered in different types of hospitals will be presented by those who are actually engaged in such work and open discussions and answers to questions will follow. It is hoped that by this method it may be possible within a short period of time to point the way to a solution of some of the perplexing problems encountered by those who are contemplating the formation of cancer clinics or engaged in their conduct.

#### INDUSTRIAL MEDICINE TRAUMATIC SURGERY

On Wednesday afternoon a Conference on Industrial Medicine and Traumatic Surgery will be held in the Rose Garden under the chairmanship of Dr. Frederic A. Besley. The program for this Conference will deal with practical subjects that are of interest to those who administer medical services in industry and to surgeons doing industrial work. Traumatic surgery in relation to insurance work and to railway work will be presented by active participants in these branches. Plastic surgery will be presented as well as the diagnosis and treatment of other specific phases of traumatic surgery. European and American surgeons will present this program and a review of the College year's work also will be presented in connection with medical service in industry.

## HOSPITAL CONFERENCE

The opening session of the nineteenth annual Hospital Standardization Conference on Monday morning in the Rose Garden of the Bellevue-Stratford Hotel will be addressed by Dr. Donald C. Balfour, President of the American College of Surgeons, Dr. George Crile, Chairman of the Board of Regents, and representatives from allied organizations who will present various phases of work which bear upon the advancement of surgery and medicine and the institutional care of the sick.

The session on Monday afternoon will be devoted to a symposium on "Adequate Care of Obstetrical Patients in General Hospitals" discussed from the viewpoint of the obstetrician, general practitioner, anesthetist, nurse, and administrator by leading obstetricians, administrators, and others who participate in this phase of hospital work.

On Tuesday morning a variety of topics will be presented by leaders in various fields who will discuss allied activities in relation to the work of hospital standardization, including in particular a discussion of the problems of the small hospital, anesthesia, nursing, medical social, dietetic, and other services.

A complete demonstration of maternal care and obstetrical technique and procedures will be presented on Tuesday afternoon in one of Philadelphia's leading hospitals.

A notable feature of the hospital conference will be a meeting for hospital trustees on Tuesday evening, the program dealing with the future of the voluntary hospital, training of hospital administrators, and the responsibility, duties, and relationship of the trustees to the hospital. This session will be of special interest to hospital executives and members of medical staffs as well as to trustees.

On Wednesday morning there will be a joint session with the Association of Record Librarians of North America, when the subject of medical records will be considered from the viewpoints of the various specialties of medicine and surgery, with a discussion on the use of the standard nomenclature of disease. Much light will be shed on medical record problems at this session, which will be followed in the afternoon by an extensive demonstration of medical records from the standpoint of medical record room organization, and the securing, appraising, and use of medical records, presented by the record librarians of the hospitals of Philadelphia, assisted by members of the administrative and medical staffs.

Thursday will be devoted to a panel round table discussion of hospital problems, including administration, government of hospital, hospital auxiliaries, medical staff organization, medical staff conferences, medical records, clinical laboratory service, x-ray service, physical therapy, occupational therapy, oxygen therapy, anesthesia, pharmacy service, medical social service, food service, nursing, purchasing, accounting, central supply, housekeeping, laundry, engineering, maintenance, hospital libraries, public relations. It is planned to give thorough consideration to the entire program during the morning and afternoon sessions, so that those present will secure the latest and best information from experts in the various subjects.

All sessions will be held in the Rose Garden of the Bellevue-Stratford Hotel, with the exception of the Tuesday and Wednesday afternoon sessions, which are to be held in two of Philadelphia's leading hospitals. A profitable time is assured everyone who attends this conference.

## HEADQUARTERS—TECHNICAL EXHIBITION

Clinical Congress headquarters will be established at the Bellevue-Stratford Hotel, which has unusual facilities for accommodating the Congress. The grand ballroom, Garden, Clover and Red Rooms and other large rooms on the first and second floors and the roof have been reserved for scientific sessions and conferences, registration and clinic ticket bureaus, bulletin boards, executive offices, etc. Thus, the activities of the Congress will be centralized under one roof.

The Technical Exhibition will be located in the ballroom and adjacent large rooms on the second floor. The registration and clinic ticket bureaus together with the registration desk will be centrally located as regards the exhibit rooms, in which will be placed the bulletin boards on which the daily clinical program will be posted each afternoon. Leading manufacturers of surgical instruments and supplies, x-ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in this Exhibition.

## ADVANCE REGISTRATION

The hospitals and medical schools of Philadelphia afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics—the limit of attend-

ance being based upon the result of a survey of the amphitheaters, operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that those surgeons who wish to attend the Congress will register in advance.

Admittance to all clinics and demonstrations will be controlled by means of special clinic tickets which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card which is non transferable must be presented in order to secure clinic tickets and admission to the evening meetings.

## PHILADELPHIA HOTELS AND THEIR RATES

In addition to the headquarters hotel the Bellevue Stratford there are several first class hotels within short walking distance of headquarters providing ample hotel facilities at reasonable rates. It is suggested that reservation of hotel accommodations be made at an early date. The following hotels are recommended by the Committee.

the Committee	Size in Rat w h l \$ apt	Do Me
Ad lpha, 3th and Ch in t Sts	\$3 5	9 00
Barcl y Rittenb use Squar E	4 00	6 00
B lgr a 8 Chest ut St	2 50	4 00
B l l Str t d Br ad and Waln t Sts	4 00	6 00
Bent m Franklin 6th and Che inut Sts	3 5	5 00
B adw od B d od Wood Sts	00	4 00
C l n l t th nd Spruc Sts	50	3 5
C gto 37th bo Ch in t St	00	3 00
D ak 5 Sp ur Sr	4 00	6 00
Lerrain B d St and F rm unt A	50	5 00
M j st c B d St a d G rd A	50	4 00
N rm nd 36th d Chest t St	30	3 5
P nasy l am 30th d Chestn t Sts	50	4 00
Ritt nb use Ch t ut t 2 nd St	00	3 50
Ritz C it B d and W l t Sts	3 5	6 00
R bert M ns 7th nd Arch Sts	2 5	4 00
Roose lt 23 d d W l ut Sts	2 5	4 00
Spruce 3th and Spru Sts	2 00	3 00
St. Jam s 3th a d W inut Sts	5	4 00
Steph Gura d 7 Chestnut St	50	4 00
Syl ania Juniper nd Loc t Sts	5 00	5 00
Walto B d and Locust Sts	5	4 00
Wara ck 7th and Locu t Sts	4 00	6 00
W lmet 6th and Walnut Sts	4 00	5 00

## COMMITTEE ON ARRANGEMENTS

*Exoc 1*  $\in C$  *minutes*

HENRY P. BROWN JR. Chairman  
GILSON C. EAGLE, Secretary

FRANCIS H. ADLER	ROBERT H. IVY
DOROTHY CASE BLECHSCHNIDT	H. P. LEOPOLD
JOHN O. BOWER	RICHARD H. MEADY, JR.
L. K. FERGUSON	FRA. CESCO MOCA TRE
BRUCE L. FLEMING	JOHN R. MOORE
KARL M. HOUZER	E. A. MULLEN
LEWIS C. SMITHFEY	

*Il s'agit de Rebe gentils et*

Abington H pital—J MONTGOMERY DEWEY.  
American H pital for D cases of the Stomach—HERBERT  
R. HAWTHORNE.  
American O cologie H pital—GEORGE M DUERRA &  
B and St c t H pital—E TRET H DICKSON  
Bryn Mawr H pital—J STEWART RODMAN  
Chester Hill H pital—WILLIAM C SIERHAN  
Children's Hospital—Dr EST G WILLIAMSON  
Childs n Ho pital of Mary J Dr x l Home—GILSO C  
E GEL.  
Cooper H spital—IRVING E DEER AT  
Delaware Co nty H pital—DEWRY HUNTON  
Fitzgerald M roy H pital—THOMAS J RYAN  
Franklin H pital—LOUIS D ENGLETS  
German town Ho pital—WILLIAM B SWARTLEY  
Gadu te Ho pital f Un nity f Pennsylv anna—WIL  
LIAM BATES BENJAMIN H SHUSTER LUTH & C  
PETER.  
Hahn ma n H pital—HERBERT P LEOPOLD H S  
W AVER S FRANK O NAGEL.  
Jean s H pital—ROSCOE W TEAHAN  
Jefferson Ho pital—EDWARD J KLOFF LOUIS H CLE  
C E G SHAN OV.  
J ub H pital—FRANK B BLOCE.  
Kensington H pital—EDWARD A SCHULMA  
Landenau H pital—D MON B PF I FER  
M monal H pital—BR CE L FLEMING  
M thodist Episcopal Ho pital—CARA N V SM TH  
Miss io dia H pital—FRANCISCO MUGAYERO  
Mount Sinai H pital—DR JAMIN LIPSHU  
Northeastern Ho pital—T TURNER T OMAS  
P y l anna Ho pital—W ESTELL LEE  
Philad lphia Gen ral H pital—L H FERGUSON ROBERT  
HUNTER  
Phl d lphia O th paedric Ho pital—D FOREST P WIL  
LARD  
P c yterian H pital—JAMES B MASON  
P ostant Ep sc pal H pital—RICHARD H MEADE JR  
ORTO C Hl st AN REV V KNOX.  
St Agnes Hospital—J W BRAN FIELD  
St Christ phe s Ho pital—HARRY E K OK.  
St J ph H pital—VER E G BURDEN  
St Lukes d Childs n H pital—DESIDERIO ROM V  
St N ry's Ho pital—JAMES A KELLY  
St Vinc nt H pital—WILLIAM F MORRISO  
Shura H pital—JOHN K MOORE  
St ton H pital—FREDERK A BOTHIE.  
Templ Un vsty H pital—W W BARCOCK, MATTHEW  
S ERNER W L LILL E.  
Un vsty IP na s i n H pital—I S RA DUN HARRY  
P SCHENCK THOMAS B H LLOW V  
W t J sey H m p th Ho pital—E S HALL GEB.  
Walls H pital—FRANCIS H ADLE  
Woman H spital—M RAGERT S TLEY  
W man M d cal Coll g H pital—S FAITH FETTERMAN  
W n n s H m p th c H pital—FRA COIS L Hc HES

## PROGRAM FOR EVENING MEETINGS

A 19-2

*President at Meeting—Monday, 8 15—Irvine Hall*

- Address of Welcome HENRY P. BROWN, JR., M.D., Philadelphia, Chairman, Committee on Arrangements  
 Introduction of Foreign Guests  
 Address of Retiring President DONALD C. BALFOUR, M.D., Rochester, Minnesota  
 Inauguration of Officers President, EUGENE H. POOL, M.D., New York, First Vice-President, EMILE HOLMAN, M.D., San Francisco, Second Vice-President, GEORGE E. WILSON, M.D., Toronto  
 The Treatment of Coronary Sclerosis and Angina Pectoris by Grafting a New Blood Supply to the Myocardium CLAUDE S. BECK, M.D., Cleveland  
 Annual Oration on Surgery SIR JAMES WALTON, M.S., F.R.C.S., K.C.I.O., London, England

*Tuesday, 8 15—Irvine Hall*

- More Conservatism in Cesarean Section FRANK W. LYNCH, M.D., San Francisco  
 Injuries of the Bones and Soft Tissues of the Face AILRAY P. BLAIR, M.D., St. Louis  
 Treatment of Fractures of the Neck of the Femur by Internal Fixation M. N. SMITH-PETERSEN, M.D., Boston  
 Fracture Oration The Essential Features of Fractures of the Shoulder GEORGE E. WILSON, M.D., Toronto

*Wednesday, 8 15—Irvine Hall*

- Symposium on Intestinal Obstruction  
 Rationalizing Treatment in Acute Intestinal Obstruction OWEN H. WANGENSTEEN, M.D., Minneapolis  
 Chronic Intestinal Obstruction Due to Lesions of the Large Bowel VERNON C. DAVID, M.D., Chicago  
 The Combined Spleen Clinic Results with Medical and Surgical Therapy in Splenopathies ALLEN O. WHIPPLE, M.D., New York  
 The Surgical Treatment of Bronchiectasis WILLIAM F. RIENHOFF, JR., M.D., Baltimore

*Thursday, 8 15—Irvine Hall*

- The Management of Severe Hyperthyroidism FRANK H. LAHEY, M.D., Boston  
 Transurethral Surgery, Its Indications, Limitations, and Complications HERMON C. BUMPUS, JR., M.D., Pasadena  
 Wertheim's Hysterectomy versus Radium in the Treatment of Carcinoma of the Cervix WILLIAM FLETCHER SHAW, M.D., Ch.B., F.C.O.G., Manchester, England  
 Resection of the Recto-Sigmoid and Upper Rectum for Cancer, with End-to-End Union J. SHELTON HORSLEY, M.D., Richmond

*Convocation—Friday, 8 15—Irvine Hall*

- Invocation  
 Presentation of Candidates for Fellowship  
 Conferring of Fellowships The President  
 Conferring of Honorary Fellowships The President  
 President's Inaugural Address EUGENE H. POOL, M.D., New York  
 Fellowship Address JUDGE HAROLD M. STEPHENS, Washington, D.C.

## SURGERY GYNECOLOGY AND OBSTETRICS

## PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY GYNECOLOGY OBSTETRICS ORTHOPEDICS UROLOGY  
NEUROSURGERY SURGICAL PATHOLOGY ETC

## JEFFERSON HOSPITAL

## Monday

ROSS V. PATTERSON—2 The use of drugs in surgical aseptic treatment of acute infection by  
WILLIS F. MANGES—3

## Tuesday

VIRGIL H. MOON—9 Shock Its mechanism and pathologic changes and sequelae illustrated  
GEORGE A. ULRICH and staff—9 Obstetrical and gynecological operations  
DAVID M. DAVIS—9 Urological operations  
ARTHUR FIRST—9 30 Sterility clinic  
J. TORRANCE RICH—9 Orthopedic operations  
P. BROOKE BLAND and staff—9 Obstetrical and gynecological operations  
CHARLES F. NARAU—9 Gynecological and urological  
JAMES CARRELL—12 Ward walks  
RAND L. MACCARROLL—2 Antenatal clinic  
JOHN B. MONTGOMERY and CHARLES LINTZEN—12  
Operations follow up clinic  
P. BROOKE BLAND and staff—12 Antenatal clinic  
demonstration of sterilization of the female genital tract  
EDWARD J. KLOPF—9 General surgery

## Wednesday

BROOKE M. ANSPACH JOHN B. MONTGOMERY and staff—9  
Gynecological operations  
WARREN B. DAVIS—9 Plastic and general surgery  
HARR. STUCKERT and staff—9 30 Gynecological and  
obstetrical operations  
P. BROOKE BLAND and staff—9 Obstetrical and gynecological operations  
DAVID M. DAVIS—9 Urological operations, demonstration of cases  
H. V. GINSBERG—9 30 Cystoscopic clinic  
ARTHUR E. BILLINGS—9 General surgery and ward walks  
EDWARD L. BAUER—2 Diagnosis and treatment of appendicitis by roentgen and obstetrics by gynecological and abdominal ward walks  
JOHN DROGER—2 Antenatal clinic  
T. L. MONTGOMERY—2 Ward walks  
P. BROOKE BLAND and staff—3 Antenatal clinic  
demonstration of laboratory clinical study of the female genital tract  
T. A. SHALLOW—9 General surgery  
MARIO C. STILO—9 Timely cases of diseases of the antenatal period, demonstration and presentation of cases

## Thursday

LEWIS C. SCHEFFER CHARLES LINTZEN and staff—9  
Gynecological operations  
WARREN B. DAVIS—9 Plastic and general surgery  
T. L. MONTGOMERY and staff—9 Obstetrical and gynecological operations  
P. BROOKE BLAND and staff—9 Obstetrical and gynecological operations  
DAVID M. DAVIS—9 Urological operations  
H. K. SLETA and P. A. McCAHILL—9 General surgery and ward walks

P. BROOKE BLAND and staff—1 30 Antenatal clinic demonstration in laboratory clinical study of sterility, parasitic infection, and fistulae  
E. J. KLOPF W. F. MANGES F. C. KOWLES, B. L. CRAWFORD and W. H. KRAEMER—3 Tumor clinic conference  
BROOKE M. ANSPACH and LEWIS C. SCHEFFER—3 Clinical conference in gynecology  
P. BROOKE BLAND—4 Obstetrical conference  
T. L. MONTGOMERY and J. BERNARD B. STEEL—4  
Manikin instruction

## Friday

WARREN B. DAVIS—9 Plastic surgery operations  
GEORGE A. ULRICH and JAMES CARRELL—9 Obstetrical and gynecological operations  
DAVID M. DAVIS—9 Urological operations  
P. BROOKE BLAND and staff—9 Obstetrical operations  
MICHAEL A. B. R. S.—9 Brain tumors  
JOHN B. FLICK—9 General surgery and ward walks  
LEWIS C. SCHEFFER and W. J. THURM—9 Urological cases, follow up clinic  
JACOB HOFFMAN—9 Endocrinological clinic  
JAMES CARRELL—12 Ward walks  
JOHN DUGGAR—2 Antenatal clinic  
ARTHUR FIRST and REGINA HOBAN—2 Big list of cases  
nephrology

## HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

## Monday

Staff—9 Pre- and postoperative care of surgical cases demonstration of cases in the Laboratory of Surgical Research

## Tuesday

I. S. K. VOLT and staff—9 General surgical operations  
C. C. MORRIS and staff—9 Gynecological operations  
A. RANDALL—9 Urological operations  
Staff—9 Demonstration in the Laboratory of Surgical Research

## Wednesday

I. I. FRIED and staff—9 General surgical operations  
C. C. MORRIS and C. B. CHAMBERS—9 Obstetrical and gynecological operations  
Staff—9 Pre- and postoperative care of surgical cases  
BRUCE GILL—9 Orthopedic operations

## Thursday

I. S. K. VOLT and staff—9 General urological operations  
F. F. KEELE—9 Gynecological operations  
BRUCE GILL—9 Obstetrical operations  
A. RANDALL—9 Urological operations

## Friday

E. L. ELIASON and staff—9 General surgical operations  
Staff—9 Obstetrical operations  
C. C. MORRIS and staff—9 Gynecological operations

## EVANS INSTITUTE

## Monday

R. H. ILLIY and L. W. K. C. ATIS—9 General surgery



# PRELIMINARY PROGRAM FOR 1936 CLINICAL CONGRESS

## TEMPLE UNIVERSITY HOSPITAL

### Monday

- CHEVALIER JACKSON and CHEVALIER L JACKSON—12 30  
Bronchoscopic clinic  
W EDWARD CHAMBERLAIN—1 Diseases of the respiratory  
tract exhibit in x ray museum  
W EDWARD CHAMBERLAIN and TEMPLE FAY—1 Hydro  
dynamics of the craniovertebral cavity, working  
model  
W EDWARD CHAMBERLAIN, CHARLES L BROWN, W  
LMORY BURNETT, CHEVALIER L JACKSON, LOUIS  
COHEN and ROBERT F RIDPATH—5 Chest confer  
ence  
LAWRENCE W SMITH—3 Surgical pathological conference

### Tuesday

- W EDWARD CHAMBERLAIN—9 Diseases of the cardio  
vascular system, exhibit in x ray museum  
W EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydro  
dynamics of the craniovertebral cavity, working  
model  
W WAYNE BABCOCK—9 General surgical clinic  
TEMPLE FAY—9 Neurosurgical operations  
J HOWARD FRICK—9 General surgical clinic  
LOUIS COHEN—10 Artificial pneumothorax ambulant  
cases  
J O ARNOLD—11 Intradermal test for pregnancy  
JOHN O BOWER and staff—12 Surgical research labora  
tory  
W EMORY BURNETT—1 Diseases of the breast  
JOHN R MOORE—2 Fractures deliberate delayed  
reduction  
W HERSEY THOMAS—3 Genito urinary clinic  
FRANK W KONZELMANN—3 Surgical pathological con  
ference  
TEMPLE FAY—4 Clinical consideration of the epilepsies

### Wednesday

- W EDWARD CHAMBERLAIN—9 Encephalography exhibit  
in x ray museum  
W EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydro  
dynamics of the craniovertebral cavity, working  
model  
W WAYNE BABCOCK—9 One stage abdominoperineal  
proctostomoidectomy with perineal anus  
J NORMAN COOMBS—9 General surgical clinic  
TEMPLE FAY—9 Conference on neurological and neuro  
surgical problems, ward rounds  
CHEVALIER L JACKSON and WILLIAM I SWALM—11  
Gastroscopy  
W EMORY BURNETT—12 Plastic surgery clinic  
W WAYNE BABCOCK and CHARLES L BROWN—1 Sur  
gical medical conference  
HARRY Z HIBSHMAN and staff—3 Proctological op  
erations  
LAWRENCE W SMITH—3 Surgical pathological conference  
TEMPLE FAY—4 Fractures of skull and cerebral trauma  
BENJAMIN GRUSKIN—4 Intradermal tests for malignancy,  
pregnancy and tuberculosis

### Thursday

- W EDWARD CHAMBERLAIN—9 Gastro intestinal and  
genito urinary tracts, exhibit in x ray museum  
W EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydro  
dynamics of craniovertebral cavity, working model  
W WAYNE BABCOCK—9 General surgical clinic  
JOHN LEENOM—9 General surgical operations, relief of pain  
TEMPLE FAY—9 Neurosurgical operations, surgical research labora  
tory  
JOHN O BOWER and staff—11 Surgical research labora  
tory

- W EMORY BURNETT—12 Thoracic surgery clinic  
CHEVALIER JACKSON and CHEVALIER L JACKSON—12 30  
Bronchoscopic clinic  
TEMPLE FAY—1 Management of convulsive seizures,  
epilepsy

- W EDWARD CHAMBERLAIN—1 Biplane fluoroscope espe  
cially adapted for bronchoscopy  
J O ARNOLD—2 Toxicin clinic Demonstration of fluid  
balance, methods, case records and results  
JOHN R MOORE—2 Orthopedic clinic Spine, angle point  
fusion, shoulder, posterior glenoid repair for luxation,  
hip, shelf procedure for shallow socket  
W HERSEY THOMAS—3 Genito urinary clinic  
FRANK W KONZELMANN—3 Surgical pathological con  
ference  
TEMPLE FAY—4 Mechanism of headache

### Friday

- W EDWARD CHAMBERLAIN—9 Bone tumors, exhibit in  
x ray museum  
W EDWARD CHAMBERLAIN—9 Hydrodynamics of cranio  
vertebral cavity, working model  
W WAYNE BABCOCK—9 General surgery  
W EMORY BURNETT—9 General surgical clinic  
TEMPLE FAY—9 Brain and cord tumors  
JESSE O ARNOLD and staff—11 Obstetrical operations  
FRANK C HAMMOND—12 Gynecological clinic  
CHARLES L BROWN—1 Cardiac patients as surgical risks  
CHEVALIER JACKSON—2 Diverticulum of the esophagus  
and hypopharynx, one stage operation  
LAWRENCE W SMITH—3 Surgical pathological conference  
BENJAMIN GRUSKIN—4 Intradermal tests for malignancy,  
pregnancy and tuberculosis  
W EDWARD CHAMBERLAIN, CHARLES L BROWN, W  
EMORY BURNETT, CHEVALIER L JACKSON, LOUIS  
COHEN and ROBERT F RIDPATH—5 Chest con  
ference

## COOPER HOSPITAL

### Tuesday

- B F BUZBY and DR CARLANDER—9 Orthopedic opera  
tions  
T B LEE and G F WEST—9 Gynecological operations  
P M MCCRAY, A S ROSS, F W SHAFER and I E  
DEIBERT—10 General surgery  
R S GAMON—10 Fracture clinic, demonstration of cases  
A B DAVIS, J HARRIS UNDERWOOD, LAWRENCE GLOVER  
and GEORGE B GERMAN—11 30 Prenatal clinic,  
demonstration of obstetrical cases  
A H LIPPINCOTT, D F BENTLEY, JR and R R BETAN  
COURT—2 Urology

### Wednesday

- P M MCCRAY, A S ROSS, F W SHAFER and I E  
DEIBERT—9 General surgery  
A B DAVIS and staff—9 Obstetrical clinic

### Thursday

- B F BUZBY and DR CARLANDER—9 Orthopedic opera  
tions  
T B LEE and G F WEST—9 Gynecological operations  
P M MCCRAY and staff—10 General surgery  
A B DAVIS, J HARRIS UNDERWOOD, LAWRENCE GLOVER  
and GEORGE B GERMAN—11 30 Prenatal clinic,  
demonstration of obstetrical cases  
A B DAVIS—2 Obstetrical operations

### Friday

- Staff—9 General surgery, operative and dry clinic

## PHILADELPHIA GENERAL HOSPITAL

## Monday

H R OWEN—130 Gen eral su g cal per ti n

## Tuesday

WILLIAM F MOORE—9 Te tment of b o c h c l a s s and pulm nary suppurat n

HENRY S RUTH—staff—9 Cyclopr j n in th raci su ge y

I D ENGLERTH—9 G ne al urgical pe ations

M P WARMUTH—9 G ne al su g c i p ations

C A BERNY—10 Treatment of gynecological can r

I S HNELESKI—1 I epa at ol int a eno s s o l u t i o s and t y d m n t i o n

RICHARD MEADE—9 M g m e t f pulmo ary t b r culo s a b y m e n s o f t i a l p n e u m o t h a x a n d f l u d o p e r a t i n

EDWARD A SCHULMANN and staff—9 Gynecological clinic

MOSES BERKEND—2 Th racic su gery

## Wednesday

HENRY S RUTH and staff—9 Tr ends in anesth etic meth ods at Ph ila d e l p h i a G e n e r a l H o s p i t a l

P A MCCARTHY and associates—9 G e n e a l u g c a l o p e r a t i o n s

JOHN BOYER and associates—9 Treatment f p d n g p e t n t i m p l i c a t i n g c e p h r i t e a p p e d c t u s e f c n a l e s e n t s e r u m a n d p e r f i n i n g n i t r i n

I S HNELESKI—1 I r p r a t i o n ( i n t r a c u s o l u t i o s a d t a y s d e m n s t r a t i o n

L H CLEGG—1 D g o s u d t r e a t m t p o c d u e f r i n t a o a l c a n c e

W G ELMER and L D FREESCOTT—3 P a t r i d h u p

## Thursday

TEMPLE FAY—9 A n o u g r y

HENRY S RUTH and staff—9 Ch i e f a n t h e t i c a g n t a f m t h o d a

L D ENGLERTH—9 G n e a l u g c a l p r i o

M P WARMUTH—9 G n e a l u g c a l p e r i o s

J C HOWELL—9 B e s t c a n c

I S HNELESKI—1 P r p a r a t i o n o f t r a e n u s a l t i s a d t r y s d e m n t r i o

JOSEPH MACFARLAND and staff—9 T u m r h n o g e n a l d i s u s o n o f m a n a g m e n t t r e a t m t a n d d i a g n o s i s o f a t y p e f m i g h a n t d i s e a s e s

W H MACKENNEY—9 U o l g i c o p a t i n s d e m o n s t r a t i o n f c a s e s

JOHN D REESE—9 P l a s t i c a n d l s u r g y

## Friday

J C HOWELL—9 C a n c e r o p e r a t i o n

P A MCCARTHY and associates—9 G n e a l u g c a l o p e r a t i o n s

H P BROWN JR and O C KILGORE—9 P r e s t h e t i c s e d a t i

I S HNELESKI—1 P r p r a t i o n f i n t a n a s o l u t i o n s a n d t y s d e m n s t r a t i o n

B P WIMANN—9 T h e r a p e u t i c p e d u r e s o f r y a n d a d u m t h a p y

## SHIRINERS HOSPITAL

## Monday

JOHN R MOORE—9 C o n g e n i t a l b o d y d i s l o c a t i o n s i n t h o d f d u t n e m p l y d i n c h i l d r e n b e t w e n a g e f 4 a n d 1 2 x r a y s l a t e r n a l s i j e s a n d c a s e i l l s t r u t i o n s C o g a l l b b f e e t H i k e m t h o d f t r e a t m t i n l a n t s l d s a d c a e i l l u t i o n A r t h r o d e s i s f t h e b l d p e t e r r a p p c h a n d p t e o g l e n o d p a i f o p o s t o r a h o l d f u t i o n

## PRESBYTERIAN HOSPITAL

## Tuesday

E B HODGE E L WILLIAMSON and L M RANKIN—9 G e n e a l u g c a l

R H IVY and L CURTIS—9 P l a s t i c s u r g e r y o f f a c e

A B CILL and T L O B—2 O r t h o p e d i c s u r g e r y

G M LAWS J P LEVINS D RIEDEL a d J F SKELL—2 Gynecological operations

C FOLLIOD P F WILLIAMS W C ELY F A MILLER and V T SHIPLEY—4 O b s t r i c t i o n a l o n c e

## Wednesday

WILLIAM BATES J B MASON and J C HOWELL—9 G e n e a l u g c a l s u r g e r y d o r s o l u m b a n e a l g i m t u n p i t u e d e m n s t r a t i o n

Staff—1 D r y c l i m e J C BEARD—1000 A b d m i n i l s y m p t o m s o f d i a b e t e s m e d c a l a p e t a F A BOYER A b d o m i n i l s y m p t o m s o f d i a b e t e s s u g c a l a p p t i s G C GRIFFITH C l i n i c i v l e o f a n b o o d p r s s u e t o t h e r g e n T A JORNSO C l i n a a p e c t s f c h r o n i c l e a d p o i s o n i n g f G SCHWABEL and F FETTER T h e f l d o f t h e r a p y a n d s e a s e s o f t h e p a n t s H T KELLY A l l e r g i c p e r m o p h y i o d i a b e t e s

Staff—2 U r i g e l c l i m e o p e r a t i v a n d d r y H SAN GREE R e n a l n e m a l s S D EARNST R e d a l t u m o r s d i a g n o s i s a n d t a t m t K E E T H F O L E A D r o n s t r u t i o n f p a t h o l o g i c a l p e c u m e s D P BROWN T h e k e t g n o d i c t a n d t r a n s i t i o n i n t h e t e n t a l f u r i n a r y i n f e c t i o n s F G HARRISON U r i n a r y c a l c u l i d t h e r m a n a g m e n t J C BIRD SALL T h e r e l a t i o n o f h y d o n e p h r i s i s t o n e p h r o t m o t n p i c t u r e d e m o n s t r a t i o n D e m n s t r a t i o n f p a t i e n t s o b s e r v e d c y s t o s c o p e a d p y l o g p h u s e x a m i n a t i o n a n d o p e r a t i n g t a b l e

## Thursday

E L ELIASON F A BOYER and J P NORTH—9 G e n e a l u g c a l s u r g e r y

C A BERNY and J C GRIFFITH—2 Gynecology

## Friday

H P BROWN JR and O C KILGORE—9 G e n e a l u g c a l

## GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

## Monday

JOSEPH C BIRDWALL L F MILLIKEN F G HARRIS and F ROGERS—2 G e n e r a l u r i n a r y s u r g e r y d e m n s t r a t i o n o f c a s e

## Tuesday

WILLIAM BATES—9 G e n e a l u g c a l s u r g e r y

WILLIAM H MACKENNEY and EDWARD A MILLER—2 G e n e r a l u r i n a r y s u r g e r y

## Wednesday

WILLIAM R NICHOLSON—9 Gynecological surgery

WALTER EYELL LEE and H L BOCKUS—9 G e n e a l u g c a l s u r g e r y

## Thursday

FRANCIS C GRANT—9 N e u r o s u r g e r y

JACOB W CUTLER—9 I n t r a p l e u r a l p u m o l y s i s

## Friday

ROBERT H IVY and LAWRENCE CURTIS—9 M a x i l l a r y s u r g e r y

W E LEE and C F MASTIN—9 L y m p h a t i c s u r g e r y

# PRELIMINARY PROGRAM FOR 1936 CLINICAL CONGRESS

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## MISERICORDIA HOSPITAL

*Tuesday*

- B R BELTRAN and E J GARVIN—9 General surgery, operative and dry clinic  
G P MULLER, F MCGWERO and F T MCGINNIS—9 General surgery, operative and dry clinic  
J A SHARKEY—10 Planned obstetrical admissions and their influence upon obstetrical mortality and morbidity

*Wednesday*

- J A KELLY and D C GEIST—9 General surgery, operative and dry clinic  
T J RYAN, J F DOUGHERTY and J B CLAFFEY—9 General surgery, operative and dry clinic  
P A LOEFFEL—10 Varicose vein clinic  
A D KURTZ—11 Orthopedic clinic  
W J MacMURTRIE—2 Toxemia of pregnancy

*Thursday*

- G P MULLER, F MCGWERO and F T MCGINNIS—9 General surgery, operative and dry clinic  
B R BELTRAN and E J GARVIN—9 General surgery, operative and dry clinic  
J V MISSETT—2 Reduction of breast complications during puerperium

*Friday*

- T J RYAN, J F DOUGHERTY and J B CLAFFEY—9 General surgery, operative and dry clinic  
J A KELLY and D C GEIST—9 General surgery, operative and dry clinic  
D C GEIST—10 Nerve lesions due to trauma  
A E BOTHE—11 Tumors of the bladder

## CHESTNUT HILL HOSPITAL

*Tuesday*

- FRANKLIN L PAYNE—9 Gynecological surgery  
J F MCCLOSKEY, J A LEHMAN and J M ELIZEY—10 General surgery  
ROBERT CADMAN—3 Allergy in surgical diagnosis  
F K ALEXANDER—4 Demonstration of unusual x ray films

*Wednesday*

- WILLIAM B SWARTLEY, S DANA WEEDE and STEPHEN WOOLSTON—10 General surgery  
EDWARD SCHULMAN and Z B NEWTON—10 30 Obstetrical operations

*Thursday*

- WILLIAM C SHEEHAN, L H HERGESHEIMER and HANS MAY—10 15 General surgery  
OWEN TOLAND, H C WOOD and W TOMPKINS—11 Obstetrical clinic and demonstration of cases  
ALEXANDER RANDALL, FREDERICK SCHOFIELD and FRANK MASSINISO—2 Genito urinary surgery  
JOSEPHUS T ULLO, EDWARD MCCLOSKEY and FRANK M RAMSEY—3 Symposium on surgical failures

*Friday*

- FRANCIS C GRANT—9 Neurosurgery  
Staff—10 30 Presentation of cases showing interesting bone lesions in traumatic surgery  
EDWARD F CORSON—1 30 Dermatological clinic, skin lesions in surgery

## ST CHRISTOPHER'S HOSPITAL

*Wednesday*

- HARRY E KNOX, JOHN WOLF and L M EBLE—Surgery of childhood

## ST AGNES HOSPITAL

*Monday*

- W H HAINES—12 30 Genito-urinary surgery

*Tuesday*

- C C MURPHY—9 General surgery  
J A MCGILLY and W B HARER—9 Gynecology  
H SANGMEISTER, W SUSSMAN and Y F YOSHIDA—9 Obstetrical clinic

*Wednesday*

- J W BRANSFIELD—9 General surgery  
G M DORRANCE—9 Plastic surgery  
L AVERETT and W SUSSMAN—9 Gynecology  
H SANGMEISTER, W B HARER and Y F YOSHIDA—9 Obstetrical clinic  
W H HAINES—2 Genito urinary surgery

*Thursday*

- A P KEEGAN—9 General surgery  
J A MCGILLY—9 Gynecology  
H SANGMEISTER, W B HARER, W SUSSMAN and Y F YOSHIDA—9 Obstetrical clinic

*Friday*

- G M DORRANCE and J W BRANSFIELD—9 General surgery  
J A MCGILLY and L AVERETT—9 Gynecology

## PROTESTANT EPISCOPAL HOSPITAL

*Tuesday*

- I M BOYKIN, J W KLOPP and R R LAYTON—9 General surgery  
I M BOYKIN—12 Dry clinic Amputations for diabetic gangrene

*Wednesday*

- H E KNOX—9 Surgical management of pyloric and duodenal obstruction in infants  
R H MEADE, JR—9 Factors influencing late results in treatment of acute perforation of peptic ulcers  
LOWRY ALLEN—9 X-ray treatment of acute surgical infections  
E T CROSSAN—9 The management of acute osteomyelitis  
JOHN KLOPP and R R LAYTON—9 The management of fractures about the ankle  
RUTHERFORD L JOHN—2 Orthopedic surgery  
ALBERT MARTUCCI—4 The management of peripheral vascular disease

*Thursday*

- E I CROSSAN, H E KNOX and R H MEADE, JR—9 General surgery

*Friday*

- I M BOYKIN, J W KLOPP and R R LAYTON—9 General surgery

## CHILDREN'S HOSPITAL OF DREXEL HOME

*Days to be announced*

- ALBERT C MARTIN—Fluid balance in postoperative treatment  
JOHN HAYD—Fractures in children  
J ALBRIGHT JONES—Abdominal pain in children Discussed by ELIZABETH KIRK ROSE  
J MONTGOMERY DEAEVER—Appendicitis in childhood  
GILSON C ENGEL—The treatment and results of hernia in children

## WOMAN'S HOSPITAL

## Monday

ELEANOR BALPH—1 Ur l gcal clinic

## Tuesday

MARGARET STURGIS—0 Ster l ty chnc

MARGARET STURGIS, ELEANOR BALPH and HELEN ANGELOCCI—0 Gynec l gcal ope at o s.

DOROTHY CAE BLECHSCHMIDT—2 Brea t clinic, dem stration of cases f ray film f B p studies, meth ods of diagnos s d sc asi n.

## Wed sday

MAR ARRY SUTLEY—0 Ge eral surgical operatio s.

ALBERTA PELTZ—10 P n tal bster ical clinic to mmas of p gnaney pen d scuss n

LIDA STEIN COGILL— Obst trical n l gesia

Staff— D m stration f w k f Social Serv ce Dep t m nt in r lation to p enatal and po tnatal cas presentation on f case f i t rest

## Th d y

DOROTHY CAE BLECHSCHMIDT—0 G n l surg c l i r l s

Staff—A D m stration f w k f Social Serv ce Dep t m nt in r lation to p enatal and po tnatal cases p sent ti n l s i nte est

## D ly D on t at n

B M MEINE Path l gcal xht

M RY EASBY Electrocardi log cal d m nat at ns, stud es of its al in ses of surgical risk

DOROTHY CAE BLECHSCHMIDT—2 M ti n p c t u s f ab d m al s rgery

## PENNSYLVANIA HOSPITAL

## T day

W F L E nd staff—0 Ge e al s gery

D L FA LE T M McMILLAN and W D STR L D—0 Med c l a pect f u g cal pr bl ms

J O BOWER— Surg l pathol gic l e fer ace

LE HERMAN—2 Ur l gcal clinic

## W d s y

E J KLOPP nd t ff—0 Ge al surgery

C G D CAN A D R B REGISTER—0 Medical a pect f u g cal p bl ms

## Th d

W F L E d staff—0 Ge al x r y

D L FA LE T M McMILLAN d W D S O D—0 M d l pect f s r g al p bl m

LE HERMAN—1 g cal clinic

J O B ER—2 s r g c l path l gne l e o f

DR C MER—2 Maxillary s g cal cl n

## F id

F J KLOPP nd staff—0 C al r g r y

R B REC S ER and G C D NC—0 M d c l a pects of surg cal problems.

## PHILADELPHIA ORTHOEDIC HOSPITAL

## W dne d y

DEFOREST P WILLARD and staff—0 Ope ti ns nd dem tration of cases

## F id y

A BRUCE C L L nd t ff—0 Operat s nd d m n tra ti n of cases

## ST LUKES AND CHILDREN'S HOSPITAL

## T day

D ROMA R W LAKER H K K ES LER d taff—0 Thy ad clinic ge eral su g cal operations.

E A TYLER—0 A sthenia d m tratio s.

WARREN C MERCER—0 (ynec l gcal and obstetr al cl ic

## Dry cl c—2

L W R B R S N Th h at and ast la y t m n relati to abd minal s r g r y with special r l to gall bladder urgery

D W KRAMER Disease n m tabolism in r lation to s r y

S L IMMERSMAN Rec gnat n f po t perat e pulmonary complicat ons

## Wed day

L ASHETT A d t ff—0 Obst trical r d gynec l g cal pe at ons.

L F MILLIKEN—0 Re al l thia is n which re al y m p th ct my has been d e or might be done to p e t t e r l c e of st

## Th d y

A W HAM FR S HA DORCK and F H DENCE—0 G d ral g cal pe ti ns

WILLIAM C HUNSICKER and staff—0 G to-un n r y cl n c

## F day

J A BROOK d staff—0 Orth sed pe at s s a l d mo t alion f cases

## LANCENAU HOSPITAL

## M d y

W H MACKENZIE—2 Ur l gcal ope at s

## Tuesday

D B PREIFFER, J M DEAYER and EDWARD BORTZ—0 Gen ral surgery pe at s and d m n tration of case

## W d s y

G I MULLER G C LAGEL, DR MAY and J KEESE—0 C n r l s r g r y p l n a d d mo tral ns.

## Th d y

D B PREIFFER J M DEAYER and EDWARD BORTZ—0 C n ral u gery p at s a d dem tation f ses

## F id s

C P MULLER (C L) and DR MAY and J KEESE—0 G e r al s r g r y pe at s and d mo t alion ns.

## METHODIST EPISCOPAL HOSPITAL

## T d y

C LAYN SMYTHE nd staff—0 G n al g cal pe t na

CRO E J SCHWARTZ nd t ff—0 Gen l s r g al pe at ns.

## Wedne day

L AYV SW TH nd staff—0 Ge l g cal pe t na

CRO E J SCHWARTZ and staff—0 C al r gery

ROY W M ILLER—0 C har n sect n f th r g d M chest e perati n for ut r n p l p e.

STEARL G MOORHEAD—1 O l g c l p e t n s.

## Th d y

K W W MOHLER—0 J f atal c k

## HAHNEMANN HOSPITAL

## Tuesday

L T ASHCRAFT, W C HUNSICKER and staff—9 Operative clinic Nephrostomy, prostatectomy, transurethral resection, Caulk-McCarthy punch, demonstration of sacrocaudal block, choice of anesthetics in urological surgery Presentation of cases of renal pathology, pyelographic studies, vesical neoplasms, results of radiation and endovesical therapy, presentation of crises urograms and cystograms, a resume of experimental studies in cortical representation of vesical function, illustrated, demonstration of pathological specimens

A B WEBSTER—9 Fracture clinic

## Wednesday

G A VAN LENNER—2 General surgery, motion picture demonstration

## Thursday

W M SYLVIS—9 General surgery  
THOMAS L DOYLE—9 30 Plastic surgery  
JOHN BROOKE—2 Orthopedic clinic

## Friday

G A VAN LENNER—9 General surgery  
J M SCHOFIELD—2 Diseases of the rectum

## Days to be announced

WILLIAM KISTLER Gastric pathology, demonstration of the Wolf-Schundler flexible gastroscope

## JEWISH HOSPITAL

## Monday

S RUBENSOHN—2 Proctology  
F C HAMMOND—4 Gynecology

## Tuesday

J B LOWNES—9 Urological operations  
M BEHREND—9 General surgery  
W H TELLER—2 General surgery

## Wednesday

F B BLOCK—9 General surgery  
M BEHREND—2 General surgery

## Thursday

C J STAMM—9 Gynecology and obstetrics  
F B BLOCK—2 General surgery

## Friday

R GOLDSMITH—9 General surgery  
A M RECHTMAN—9 Orthopedic surgery  
W H TELLER—2 General surgery

## STETSON HOSPITAL

## Tuesday

F A BOTHE, J B MASON and JOHN WOLF—9 General surgery, diseases of the thyroid

## Wednesday

STEPHEN E. TRACY—9 Gynecological clinic  
WILLIAM T. ELLIS—12 General surgery  
CARL F. KOENIG—2 X-ray clinic

## Friday

STEPHEN E. TRACY—9 Gynecological clinic

## ST MARY'S HOSPITAL

## Tuesday

JAMES V KELLY—9 Surgical clinic  
HENRY K SEELAUS—9 Surgical clinic  
WILLIAM F MORRISON—10 30 Gynecological clinic  
LEO J WOJCZYNSKI—10 30 Gynecological clinic

## Wednesday

ARTHUR P KEEGAN—9 Surgical clinic  
JOSEPH TOLAND—9 Gynecological clinic  
EDWARD A WEISS—10 30 Surgical clinic  
J J CANCELMO—10 30 Surgical clinic

## Thursday

WILLIAM J RYAN—9 Surgical clinic  
P A MCCARTHY—9 Surgical clinic

## Friday

HENRY K SEELAUS—9 Surgical clinic  
H A WALSH—9 Surgical clinic  
JOHN G SABOL—10 30 Surgical clinic  
WILLIAM J WALSH, JR—10 30 Surgical clinic

## NORTHEASTERN HOSPITAL

## Tuesday

T T THOMAS and J C SCOTT—11 Fracture clinic, motion picture demonstration

## Wednesday

FREDERICK E KELLER and ALFRED H DIEBEL—9 Gynecological operations  
T T THOMAS and J C SCOTT—11 Fracture clinic, motion picture demonstration  
J B LOWNES and HAROLD LIPSHUTZ—2 Genito urinary clinic

## Thursday

T T THOMAS and J C SCOTT—11 Fracture clinic, motion picture demonstration  
FREDERICK E KELLER and ALFRED H DIEBEL—3 Obstetrical clinic, demonstration of cases

## Friday

T T THOMAS and J C SCOTT—11 Fracture clinic, motion picture demonstration

## AMERICAN HOSPITAL FOR DISEASES OF THE STOMACH

## Tuesday

F A MANTZ and S A EGER—9 General surgical operations  
L F MILLIKEN—2 Surgical treatment of hydronephrosis

## Wednesday

H R HAWTHORNE, W W OAKS and P H NEESE—9 General surgical operations  
A A LUCINE—11 General surgical operations

## Thursday

F A MANTZ and S A EGER—9 General surgical operations  
T A GRECO—11 Alexander Pfannenstiel operation for retroversion, interposition operation

## Friday

H R HAWTHORNE, W W OAKS and P H NEESE—9 General surgical operations  
A A LUCINE—11 General surgical operations

## WOMAN'S MEDICAL COLLEGE HOSPITAL

## Tuesday

J S RODMAN and associates—11 General surgery

## Thursday

LILA STEWART COGILL and CONSTANCE VOLK—9 Postnatal clinic

HELEN M ANGELUCCI—9 Treatment of trichomonas vaginalis

FAITH FETTERMAN—9 Postirradiation lesions (urinary tract)

LIDA STEWART COGILL—11 Ward walks with demonstration of interesting cases

MARGARET STUBBS and ELEANOR BALPH—11 Sterility clinic Tubal insufflation and hypodermic injections

ALYN GRAY TAYLOR—1 Prenatal clinic

CATHERINE MACFARLANE and FAITH FETTERMAN—3 Gynecological operations

CATHERINE MACFARLANE and VIRGINIA KNECHT—3 30 Treatment of dysfunctional uterine bleeding

## MOUNT SINAI HOSPITAL

## Monday

M BEHRER—1 15 General surgical operations

## Tuesday

E L ELIASO—9 General surgical operations

B LIPSHUTZ—9 General surgical operations

M M CRAY—1 30 Urological operations

## Wednesday

C MAHER—9 Gynecological operations

M COO ERMAN—2 Orthopedic surgery

## Thursday

B MAHER—9 Gynecological operations

M MISCHER—1 30 Urological surgery

## Friday

B LIPSHUTZ—9 General surgical operations

M BEHRER—1 15 General surgery

## JEANES HOSPITAL

## Tuesday

ROSCOE W TEABAN, CLARENCE A. WHITCOMB WILLARD  
S HASTINGS ELWOOD F DOWNS, HORE WAMMOCK  
and B F WRIGHT—9 Application of radium (1)  
for carcinoma of cervix (1) for carcinoma of uterine  
fundus. Demonstrations: Postoperative radiation  
endometrial biopsy in benign breast tumors; treatment  
of carcinoma of skin

## Thursday

ROSCOE W TEABAN, CLARENCE A. WHITCOMB WILLARD  
S HASTINGS ELWOOD F DOWNS, HORE WAMMOCK  
and B F WRIGHT—9 Application of interstitial  
radium for carcinoma of breast; abdominal-perineal  
resection for rectum. Demonstrations: Effects of  
radiation on tumor cells; the ordinary case of cancer  
patient; treatment of carcinoma of skin; treatment of  
gynecolgia.

## ST VINCENT'S HOSPITAL

## Wednesday

WILLIAM F MORRISON—10 Gonorrhea of the female  
tract with complications.

## AMERICAN ONCOLOGIC HOSPITAL

## Tuesday

GEORGE M DORRANCE—12 Conference on neoplastic diseases

GEORGE M DORRANCE—2 Plastic surgery and surgery of malignancy

## Wednesday

GEORGE M DORRANCE—12 Conference on neoplastic diseases

## Thursday

STEPHEN E. TRACY—9 Carcinoma of uterus

GEORGE M DORRANCE—12 Conference on neoplastic diseases

GEORGE M DORRANCE—2 Plastic surgery and surgery of malignancy

## Friday

GEORGE M DORRANCE—12 Conference on neoplastic diseases

## ST JOSEPH'S HOSPITAL

## Tuesday

WILLIAM J THURGOOD—9 Obstetrics and gynecology  
F HUBERT MAHER—1 30 The value of the Fothergill  
operation in the treatment of uterine prolapse

## Wednesday

CHARLES F VASSAU—9 General surgery

## Thursday

WILLIAM J THURGOOD—9 Obstetrics and gynecology  
F HUBERT MAHER—1 30 The value of the Fothergill  
operation in the treatment of uterine prolapse

MELVIN M FRANKLIN—1 An explanation of present high  
mortality in acute appendicitis

## Friday

ALBERT C BURDEN—9 General surgery  
CLINTON S HERMAN—10 30 General surgery

## WOMEN'S HOMEOPATHIC HOSPITAL

## Tuesday

F L HUGHES—9 Gynecological clinic

B F BUSCOE—1 Obstetrical clinic

J K ROCHESTER—2 Surgical clinic

## Wednesday

R W LARSEN—1 Surgical clinic

## Thursday

LAWRENCE GOLDBACHER—2 Proctology

## Friday

W C MERCER—9 Gynecological clinic

## CERMANTOWN HOSPITAL

## Tuesday

E B HODGE, W B SVARTLEY, C D WEEDE and R S  
ALSTON—10 30 General surgical clinic

Dr. McLaughlin and S. S. Woolston—1 30 Postoperative  
clinic

## Wednesday

STANLEY Q WEST—9 Urological operations

C F MITCHELL, W E LEE, H E KNOX and T M DOWNS  
—9 30 General surgical clinic

W E LEE and T M DOWNS—2 Thoracic surgery

# PRELIMINARY PROGRAM FOR 1936 CLINICAL CONGRESS

## FITZGERALD-MERCY HOSPITAL

Tuesday

J A KELLY and T J RYAN—9 General surgery  
W B HARER—11 Gynecology

Wednesday

B R BELTRAN and A BURKE—9 General surgery  
J MISSETT—11 Gynecology

Thursday

J A KELLY and T J RYAN—9 General surgery  
J MCGLENN—11 Gynecology

Friday

B R BELTRAN and A BURKE—9 General surgery  
W B HARER—11 Gynecology

## BRYN MAWR HOSPITAL

Tuesday

A BILLINGS and staff—10 General surgery

Wednesday

W E LEE and staff—2 General surgery

Thursday

J S RODMAN and staff—10 General surgery  
LEON HERMAN—2 Urological operations

## DELAWARE COUNTY HOSPITAL

Days to be announced

DEURY HINTON and LYNN RANKIN General surgical operations  
CLIFFORD B LULL and J V ELLSON Gynecological clinic

## CHILDREN'S HOSPITAL

Days to be announced

W E LEE, DR ROBBINS and O KING General surgery  
ROBERT IVY Plastic surgery  
JESSE NICHOLSON Orthopedic surgery

## SURGERY OF THE EYE, EAR, NOSE, AND THROAT

### TEMPLE UNIVERSITY HOSPITAL

Monday

CHEVALIER JACKSON and CHEVALIER L JACKSON—12 30  
Bronchoscopic clinic.  
WALTER I LILLIE and staff—3 Ophthalmology

Tuesday

ROBERT F RIDPATH—2 Voice production  
CHEVALIER JACKSON and CHEVALIER L JACKSON—2  
Cancer of the larynx  
MATTHEW S ERSNER—2 30 Modern concepts of deafness

Thursday

CHEVALIER JACKSON and CHEVALIER L JACKSON—12 30  
Bronchoscopic clinic  
MATTHEW S ERSNER—2 30 Otological clinic  
WALTER I LILLIE—3 Ophthalmology

Friday

MATTHEW S ERSNER and EDWARD MITCHELL—2 30 Otological clinic  
ROBERT F RIDPATH—2 Lothrop operation on frontal sinus

## FRANKFORD HOSPITAL

Tuesday

LOUIS D ENGLETH—9 Surgical clinic  
GEORGE C HANNA and associates—2 Obstetrical cases

Wednesday

WILLIAM E PARKE—9 30 Gynecological clinic

Thursday

C F NASSAU—9 Surgical clinic

Friday

LOUIS D ENGLETH, BENJAMIN H CHANDLEE and RALPH W LORRY—9 Fracture demonstration

## KENSINGTON HOSPITAL

Thursday

EDWARD A SCHUMANN, WILLIAM E PARKE, A D VOEGELIN, J V MISSETT, JR, SAMUEL STERN, Z B NEWTON and F J KOWNACKI—1 Gynecological and obstetrical clinics

## BROAD STREET HOSPITAL

Wednesday

WARREN C MERCER and staff—3 Gynecological clinic

Friday

WARREN C MERCER and staff—9 Obstetrical clinic

## ABINGTON HOSPITAL

Wednesday

ALEXANDER RANDALL—9 Urological operations  
D B PFEIFFER, C SMYTHE, J W LEVERING, I BOYKIN, J M DEEVER, GEORGE M PIERSON and DR EDMAN—2 General surgical clinic Operations and demonstration of cases

## PRESBYTERIAN HOSPITAL

Monday

G M COATES, W L CARISS and staff—2 Otolaryngology  
H M LANGDON, J THORINGTON and staff—3 Ophthalmological operations and demonstration of cases

Wednesday

G M COATES, W L CARISS and staff—2 Otolaryngology

Friday

G M COATES, W L CARISS and staff—2 Otolaryngology

## JEWISH HOSPITAL

Monday

A BRAV—1 Ophthalmological clinic.

Thursday

H M GODDARD—2 Submucous resection with nasal suction curette

Friday

A BRAV—1 Ophthalmological clinic

## HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Monday

GEORGE M. COATES and staff—2 Otolaryngological operations  
 HORACE WILLIAMS— Otolaryngological operations.

Tuesday

GABRIEL T. CAER—9 Bronchoscopic clinic  
 GEORGE M. COATES and staff—2 Demonstration of otolaryngological case and conference  
 T. B. HOLLOWAY and staff—2 Ophthalmological surgery  
 A. G. FEWELL—2 Ophthalmological surgery  
 ALFRED COWAN—2 Ophthalmological surgery  
 WILFRED FRAY—2 Ophthalmological surgery  
 P. J. HODGES—5 Rheumatism  
 JAMES A. BARRETT—30 Otolaryngological clinic  
 HORACE WILLIAMS—3 Otolaryngological clinic

Wednesday

Oscar V. BAYON—10 Otolaryngological clinic demonstration of anatomical and dissection material  
 F. R. CLARK and associates—2 Microscopic demonstration of surgical lesions following surgical injury to ear  
 GEORGE M. COATES and staff—2 Otolaryngological operations  
 F. H. CAMPBELL—2 Otolaryngological operations

Thursday

GABRIEL T. CAER—2 Bronchoscopic clinic  
 T. B. HOLLOWAY and staff—2 Ophthalmological clinic  
 WILFRED FRAY—2 Ophthalmological operations and demonstration of cases  
 A. G. FEWELL—2 Ophthalmological operations and demonstration of cases  
 ALFRED COWAN—2 Ophthalmological operations and demonstration of cases  
 GEORGE M. COATES and staff—2 Otolaryngological conference  
 E. P. FENDEL—2 Ophthalmological operations  
 KARL M. HOLLER—30 The common cold  
 RICHARD A. KER—3 Nasal surgery in all ages and conditions  
 EDWARD H. CAMMELL—3 Status lymphatic  
 H. P. SCHWARTZ—4 Chondrocytic lesions

Friday

GEORGE M. COATES and staff—2 Otolaryngological operations  
 KARL M. HOLLER—2 Otolaryngological operations  
 T. B. HOLLOWAY and staff—2 Ophthalmological surgery  
 WILFRED FRAY—2 Ophthalmological clinic  
 ALFRED COWAN—2 Ophthalmological clinic  
 A. G. FEWELL—2 Ophthalmological clinic

## HAHNEMANN HOSPITAL

Tuesday

H. S. WEAVER and staff—2 Otolaryngological clinic.

Wednesday

H. S. WEAVER and staff—2 Otolaryngological clinic

Thursday

H. S. WEAVER and staff—2 Otolaryngological clinic.

Friday to be announced

FRANK O. VALE—230 Ophthalmological operations.

## WILLS HOSPITAL

Monday

FRANK C. PARKER—2 Operations  
 THOMAS A. O'BRIEN—2 Dry clinic

Tuesday

Staff—9 Dry clinic.  
 ALFRED COWAN—2 Slit lamp technique  
 MILTON J. GRISCOM—2 Unusual external diseases  
 EDWARD B. SPARTAN—2 Plastic surgery of the lids  
 LEIGHTON F. APPLEMAN—2 Testing of the pharynx  
 WALTER I. LILLIE—2 The localizing value of nasal field changes.

FRANCIS H. ADLER—2 Operations

Wednesday

Staff—9 Dry clinic  
 ALFRED COWAN—2 Slit lamp technique  
 MILTON J. GRISCOM—2 Unusual external diseases  
 EDWARD B. SPARTAN—2 Last surgery of the eyelids  
 LEIGHTON F. APPLEMAN—2 Testing of the pharynx  
 CHARLES R. HEED—2 Fundus diagnosis  
 WALTER I. LILLIE—2 The localizing value of nasal field changes.

THOMAS A. O'BRIEN—2 Dry clinic

FRANK C. PARKER—4 Operations

Thursday

F. H. ADLER—2 Operations.

Friday

THOMAS A. O'BRIEN—2 Operations

F. C. PARKER—230 Operations

## GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Monday

RALPH BUTLER WILLIAM C. WOOD HENRY A. SCHWARTZ and staff—2 Rhinological clinic, operations and demonstration of cases  
 WALTER ROBERTS HENRY DINTZ and staff—2 Otolaryngological operations and demonstration of cases.

Tuesday

GEORGE M. COATES and staff—2 Otolaryngological operations and demonstration of cases.  
 GEORGE M. COATES SAMUEL R. SMITH JR. HERMAN B. COHEN and ROMEO L. LONCO—2 Rhinological clinic, operations and demonstration of cases.  
 BENJAMIN H. SUWITZ HERMAN B. SLOVITZ MARTIN STEINBERG and ALBERT F. MORI—2 Otolaryngological examinations.

Wednesday

GEORGE B. WOOD SAMUEL COHEN PHILIP STOKES FRANK O. HENDRICKSON GEORGE E. JOHNSON and staff—2 Otolaryngological clinic nasal plastic surgery  
 LUTHER C. PETER—230 Ophthalmological operations.

COOPER HOSPITAL  
(Chestnut & J)

Monday

J. S. SHIPMAN and staff—2 Eye surgery

Tuesday

O. R. KLINE L. B. HIRST and J. P. BRENNAN—2 Nose and throat surgery



# PRELIMINARY PROGRAM FOR 1936 CLINICAL CONGRESS

## ST LUKE'S AND CHILDREN'S HOSPITAL

*Monday*  
J W POST and IRINA W BURGL—2 Clinical and x ray study of bronchography

*Wednesday*  
GEORGE MACKENZIE—2 Nose and throat operations  
PHILIP S STOUT—2 Tonsillectomy by eversion method, modified radical mastoid

*Thursday*  
S H BROWN, F C PETERS and staff—2 Ophthalmological operations

*Friday*  
C A BRUMM and staff—2 Nose and throat operations

## ST AGNES HOSPITAL

*Monday*  
F J KELLY—4 Eye clinic

*Tuesday*  
D SULLMAN and A S GIORDANO—12 30 Nose and throat clinic

*Thursday*  
L D SULLMAN and A S GIORDANO—12 30 Nose and throat clinic

*Friday*  
G F J KELLY—12 30 Eye clinic

## CHESTNUT HILL HOSPITAL

*Tuesday*  
JOHN B DAVIES and GEORGE T FARIS—2 Otolaryngological operations

*Wednesday*  
B D PARISH and F TRAGANZA—2 Otolaryngological surgery

*Thursday*  
CARL WILLIAMS—1 30 Ophthalmological surgery

*Friday*  
CHEVALIER JACKSON—9 30 Bronchoscopy

## WOMAN'S HOSPITAL

*Monday*  
EMILY L VAN LOON—2 Bronchoscopy clinic Role of bronchoscopy in treatment of asthmatic cases, showing of x-ray films and case discussions

*Wednesday*  
HENRIETTA TAYNER—3 Otolaryngological operations

*Thursday*  
MARY BUCHANAN—2 Surgery of the eye, removal of cataract

## AMERICAN HOSPITAL FOR DISEASES OF THE STOMACH

*Tuesday*  
G H DENNEY—3 Eye operations

*Friday*  
J C HESS—2 Nose and throat operations

*Day to be announced*  
R J HUNTER Nose and throat operations

## MOUNT SINAI HOSPITAL

*Monday*  
M LINSNER—2 30 Otolaryngological clinic

*Tuesday*  
D HUSIK—2 Otolaryngological clinic

*Wednesday*  
G TUCKER—9 Bronchoscopic clinic  
M WEINSTEIN—2 Otolaryngological clinic  
B F BAUER—5 Eye operations

*Thursday*  
M LINSNER—2 30 Otolaryngological clinic  
A BARLOW—4 Eye operations

*Friday*  
D HUSIK—2 Otolaryngological clinic

## PROTESTANT EPISCOPAL HOSPITAL

*Monday*  
J A BERTOLET and staff—2 Nose, throat and sinus surgery

*Tuesday*  
K A KASPER—4 Anatomy of the nasal accessory sinuses

*Thursday*  
NELSON M BRINKERHOFF—2 Ophthalmological clinic

*Friday*  
OTTO C HIRST and staff—2 Nose, throat and sinus surgery, relocation of the triangular cartilage

*Days to be announced*  
NELSON M BRINKERHOFF—2 Ophthalmological clinic

## ANDREW KNOX HOSPITAL

*Monday*  
C T MCCARTHY—2 Otolaryngology

## FITZGERALD-MERCY HOSPITAL

*Monday*  
C T MCCARTHY—2 Otolaryngology

*Tuesday*  
H S BUSLER—2 Otolaryngology

*Wednesday*  
J LOFTUS—2 Otolaryngology

*Thursday*  
C T MCCARTHY—2 Otolaryngology

*Friday*  
H S BUSLER—2 Otolaryngology

## JEFFERSON HOSPITAL

*Tuesday*  
H H LOTT—9 Nose and throat operations  
CHARLES E G SHANNON—2 Eye operations

*Wednesday*  
LOUIS H CLERF—12 Otolaryngological clinic  
AUSTIN T SMITH—10 Nose and throat operations

*Thursday*  
A J WAGERS—9 Nose and throat operations  
LOUIS H CLERF—1 Bronchoscopic clinic

*Friday*  
CHARLES E G SHANNON—3 Eye operations

## ST JOSEPH'S HOSPITAL

Monday

ARTHUR WINGLEY—2 Otolaryngol gy

Tuesday

CORNELIUS T. MCCARTHY—2 Otolaryngol gy

Wednesday

ROBERT L. DICASON—2 Otolaryngology

Thursday

THOMAS A. O'BRIEN—2 Ophthalmology

Friday

THOMAS F. GOVEN—2 Ophthalmology

CHARLES J. TES—3 Ophthalmolgy

## MISERICORDIA HOSPITAL

Monday

J. R. BRENNAN—2 Nasal hyperesthesia treatment by zinc nitration

Wednesday

G. BRIEL TUCKER—2 Bronchoscopic clinic

Thursday

C. T. MCCARTHY—2 Three cases of laryngeal tumors with report

Friday

J. A. LOTTUS—2 Mastoidectomy

## PENNSYLVANIA HOSPITAL

Tuesday

L. ERIC C. EVES and staff—2 Otolaryngological operations and demonstration of cases

Friday

L. ERIC C. EVES and staff—2 Otolaryngological operations and demonstration of cases

## JEFFERSON MEDICAL COLLEGE

Thursday

J. LARSON S. SCHAEFFER—2 Demonstration in the Daniel Haugh Institute of Anatomy Clinical studies in the laryngeal anatomy of the paranasal sinuses

## WOMAN'S MEDICAL COLLEGE HOSPITAL

Wednesday

CHESTER J. ASH and EMILY L. VAN LOON—gynecological clinic

## FRANKFORD HOSPITAL

Thursday

FRA. FERRERY and associates—2 Otolaryngological clinic

## CHILDREN'S HOSPITAL

Days to be announced

A. FENWELL—2 Otolaryngological surgery

## ST MARY'S HOSPITAL

Tuesday

R. T. M. DOUGHERTY—2 Ophthalmology

Wednesday

FRANK J. MURPHY—2 Ophthalmology

Thursday

WILLIAM F. GRADY—2 Otolaryngology

E. J. MURPHY—2 Otolaryngology

R. T. M. DOUGHERTY—2 Ophthalmology

Friday

FRANK J. MURPHY—2 Ophthalmology

## ABINGTON HOSPITAL

WALTER HILGSON and staff—2 Demonstration in Otolaryngological Research Laboratory Apparatus and general equipment required for recording experimental in suction with physiology of the ear experimental will be done to demonstrate the technical approach to the study of both ear and bone conduction

## UNIVERSITY OF PENNSYLVANIA

Wednesday

OSCAR V. DAYSON—2 Demonstration in the Medical Laboratory Lecture demonstrations and presentation of otolaryngological anatomical material

## CHILDREN'S HOSPITAL OF Drexel Home

Days to be announced

RALPH BUTLER—2 Mastoids in children.  
J. A. B. WHITE—2 The problems of the nose and throat in children

## WOMEN'S HOMEOPATHIC HOSPITAL

Friday

C. V. FAIR—2 Ophthalmology

J. R. CRISWELL—2 Otolaryngology

## BROAD STREET HOSPITAL

Thursday

G. J. PALLEN and C. J. HART—gynecological clinic

## METHODIST EPISCOPAL HOSPITAL

Tuesday

WALTER ROBERTS and staff—2 Otolaryngological clinics

## LANGFORD HOSPITAL

Days to be announced

WILLIAM T. SUGEMAKER—2 Ophthalmological clinic

## STETSON HOSPITAL

Monday

C. H. GRIMES—2 Otolaryngological clinic

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE RISK TO THE INFANT IN BREECH DELIVERY

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From the Department of Obstetrics, Harvard Medical School and the Boston Lying In Hospital

FOR a decade and a half the problem of fetal and neonatal mortality in breech delivery has been the subject of lively interest and discussion among obstetricians. In 1926 Irving and Goethals (8) reviewed 10 years of experience with this problem at the Boston Lying In Hospital, and the present article is submitted as a detailed survey of the same subject covering twenty-two years in the same institution.

### DEFINITION OF TERMS

Since this article is intended to be a clinical study rather than a presentation of vital statistics in a bureaucratic sense, and since it is concerned with all primary breech deliveries over a specified period, stillbirths as well as neonatal deaths are included in the fatalities. A stillbirth is defined as a newborn infant which never breathed after delivery, a neonatal death is a death which occurred after the establishment of independent respiration. The term *gross mortality* is used to denote the ratio of total stillbirths and neonatal deaths to total deliveries in the series, it is also used to indicate the same ratio among the increments of premature, immature, and mature infants, from which the entire series is derived. *Crude mortality* is used to signify the incidence of stillbirths and neonatal deaths in each group into which the material is divided on any basis other than the maturity of the infant. *Corrected mortality* is the term selected to express

the combined stillbirth and neonatal death rate among infants which, theoretically, should have been born alive and should have survived. *Neonatal mortality*, in so far as the term is used in this paper, mostly for purposes of comparison, expresses the ratio of neonatal deaths to living births in any given group or category, and may be computed as *gross*, *crude*, or *corrected*, in accordance with the definitions previously given.

### INCIDENCE OF BREECH DELIVERY

From January 1, 1913, to January 1, 1935, 30,655 patients were delivered on the house service of the Boston Lying In Hospital. Of these, 1,219 women were delivered through the pelvis of 1,242 infants by the primary breech mechanism. Those cases of abdominal cesarean section in which the breech presented at the time of operation, regardless of whether the presentation was considered the essential or contributory indication for section, are not included within the scope of this paper. Otherwise all breech deliveries are reported, without regard to the time in gestation when labor occurred, consequently, the series includes infants of all postconceptional ages and all birth weights from the obvious non-viability of miscarriage, through the gradations of prematurity, to full term. The total number of infants born includes those resulting from 23 labors in which each of a pair of twins presented by the breech.

TABLE I—GROSS MORTALITY IN BREECH DELIVERY BY YEARS

	Delivered	Well	Stillborn	Dead	Macerated	Melancholia	Premature	In utero deaths	Mechanical deaths	Mortality %
1923		3	5	8	3		3			3
1924		4	3	5					3	3.3
1925	8	8	3						4	35.7
1926	3	9	6	8	4		6			3.1
1927	5	3	8				9	3		38.4
1928	3		6	6			5			35
1929	37		7	8			7			49.5
1930	9	9	8	1					6	3
1931	37	8		7					4	3
1932	36	3	3	3						6.6
1933		3	3	3					5	4.5
1934	3	37	9						5	5
1935	69	5	8		5		8	3		6
1936	79	34	3		3		8	6	4	3.6
1937	83	68	8	7			5		6	8
1938	6	55			4				6	
1939	15		7	8		1	1		3	
1940	99	78				6		6	5	
1941	84	63		7	6		8		4	6
1942	86	68	9	9	7		5			6
1943	8	65	8			3	7	1	5	1
1944	85	66		8	5			3	6	3
	9	63	57	61	35	9	5	79	1.7	

Breech delivery therefore occurred in 3.07 per cent of all births during the 22 year period

#### GROSS MORTALITY IN BREECH DELIVERY

Of the 1,242 infants delivered 922 left the hospital alive 320 were discharged dead of which 163 were stillborn and 157 died in the neonatal period. The gross mortality therefore was 25.7 per cent or stated in another manner there were 131 stillbirths and 126 neonatal deaths per thousand breech births. Figures are available for the years 1924 through 1934 corresponding exactly to the second half of the period covered by this survey which indicate that in the general incidence of all hospital deliveries 62 stillbirths and 22 neonatal deaths occurred in each thousand births (1). These comparative figures serve to show the marked increase in risk to which the infant is exposed by the circumstance of breech delivery.

#### CLASSIFICATION OF CAUSES OF STILLBIRTHS AND NEONATAL DEATHS

Table I indicates the gross mortality in breech delivery at the Boston Living In Hospital during the years covered by this survey. To any student of birth fatalities it soon becomes evident that cases tend to group themselves into various categories from a clinical standpoint. Thus certain babies are stillborn following intra uterine death at some interval before labor occurs and are therefore delivered in a state of maceration others are congenitally deformed some are born prematurely before any hope of viability can be expected certain others succumb to the mechanical hazards of the birth mechanism and a few are stillborn or die of the effects of accidental complications of birth or of conditions entirely unassociated with delivery. Such a grouping of causes of death can be effected along clinico-anatomical lines with a fair de-



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TABLE III—NEONATAL DEATHS—CLINICAL DIAGNOSES FROM THE RECORD				
Total	Maternal	Malformation	Premature	1 year or less

[illegible]

Study of the individual records and diagnoses of death correlated with the classifications in Tables II and III indicates a reasonable accuracy of such correlation in most instances. Thus stillbirths and deaths from asphyxia intracranial (cerebral) hemorrhage difficult delivery etc fall naturally into the mechanical group for the most part with a few in the intercurrent classification. The macerated and malformed infants are grouped automatically. The diagnosis of prematurity as a cause of stillbirth is not admitted in the groupings and non viable stillbirths are found in all case to be accounted for by reasons other than prematurity. Neonatal deaths from prematurity are found to be due to mechanical or intercurrent causation in 75 per cent of the cases so diagnosed. The intercurrent deaths prove the hardest of all to classify while 14 of the 51 were due to unpredictable complications such as maternal toxemia or infection antepartum and atelectasis bronchopneumonia congenital heart and hemorrhagic diathesis postpartum the balance including accidents of labor of one sort or another might with some justification

tion be considered as mechanical on the other hand death might well not have occurred but for the fortuitous complication and the inclusion of such cases in the intercurrent category seems indicated

Postmortem examination 1 recorded in 39 of the 320 fatal cases an incidence of 12.1 per cent. One macerated fetus was thus examined and three monstrosities. One infant in the premature category came to autopsy as did 6 who died of intercurrent causes and 28 of the 79 or 35.4 per cent who succumbed to mechanical conditions. While in the last named group confirmatory anatomical evidence of birth trauma or of a phylia was found in all cases it must be conceded that the series is disappointing in its lack of postmortem data on infants classed as dying of prematurity

THE FACTOR OF PREMATUREITY AND ITS BEAR-  
ING ON FETAL AND NEONATAL MORTALITY

premature infants

THE FACTOR OF PREMATUREITY AND ITS BEARING ON FETAL AND NEONATAL MORTALITY

*Gross mortality among premature infants*  
It has already been noted that all infants born by the primary breech mechanism are recorded in this series regardless of the stage of gestation in which labor occurred. Some



TABLE V—GROSS MORTALITY IN BREECH DELIVERY AMONG PREMATURE IMMATURE AND MATURE INFANTS—INCIDENCE OF PREMATURITY

	Deliv- es	Wt lb	Stillborn	Died	M t d t rma	M t t rma	P e- m re	I t curr del d b	Mo ch cal de th	Mort lty %
Prematur by w ght	40	19	67	60	0	1	86	4	6	67.8
Prematur unweighed	5					4	3	6		70.4
Immatur by w ght					3	5	3	5		6
Immatur weighed	5		2		3			1		60.0
M t re by w ght	8	7	5	39				7	5	
M t re, ghed	7		7		5					60.0
M t ty w gh d										60.0
T tal deliv- es by w ght	4	6	3	5	3	0	90	4	11	6.3
T tal deliv- es unweighed	35		3	6		6	3	7		60.4
T tal deliv- es		9	63	57	63	15	90	5	9	57

Incidence  
Prematur  
Immatur  
M t ty  
w gh d

By weight, % T tal deliv-  
es %  
1-4 7  
67 65.9

The gross mortality in premature infants in this series may be reckoned either as 167 stillbirths and deaths in 246 premature infants delivered or as 192 fatalities in 271 deliveries. The gross mortality therefore is either 67.8 per cent or 70.4 per cent. Eliminating the stillborn the neonatal death rate amounts to 35.8 per cent or 56.8 per cent respectively in the weighed and total groups. These figures are considerably in excess of the 38 per cent neonatal death rate among prematures in the hospital at large for the period 1923 through 1933 (4).

Table IV indicates that among premature breech born infants stillbirths and neonatal deaths claim more than 50 per cent of those weighing less than 3 pounds 8 ounces. The neonatal death rate among live born infants is also in excess of 50 per cent below this birth level (Table VI). That the same mortality holds in general for newborn prematures is also shown in Table VI (6). When however the weight of the infant exceeds this figure the risk of birth decreases much more rapidly with increasing poundage in infants in general than in those born by the breech.

The conclusions to be drawn from our figures concerning the incidence of prematurity in breech born babies and from the gross mortality in this group may be expressed as follows:

1. Prematurity occurs at least three times as frequently in infants born by the breech as in newborn infants in general.

2. Three pounds and 8 ounces is the minimum weight level at which a premature newborn has an even chance of survival whether born by the breech or any other mechanism.

3. Breech delivery of premature infants is associated with a higher mortality in weight groups above the 3 pound 8 ounce level than is to be found in delivery of premature infants in general in similar weight groups.

4. Not only is prematurity an important factor in the gross mortality of breech born babies, breech birth is an equally important factor in the mortality of premature babies.

*Gross mortality among immature infants.* In this series 146 babies weighed between 5 and 6 pounds at birth. Twelve were stillborn and 12 died in the neonatal period. The gross mortality was therefore 16.4 per cent of weighed infants and the neonatal mortality was 8.9 per cent of babies born alive. If we arbitrarily assume that the 5 unweighed infants born between 8 and 9 months were immature the figures are respectively 19 per cent and 10.2 per cent. Since general neonatal mortality for immature infants in the years 1932 and 1933 was 3.1 per cent (6) it is evident that breech presentation increases the risk of birth for the immature infant approximately three fold.



# GOETHALS THE RISK TO THE INFANT IN BREECH DELIVERY

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*Gross mortality among mature or full term infants* The total series of breech born infants includes 812 which, by weight, were classified as mature, together with 7 full term babies whose birth weights were not recorded. Of the weighed babies, 52 were stillborn, and 39 died neonatally, of those not recorded were stillbirths. The gross mortality was therefore 11.2 per cent or 11.9 per cent, and the neonatal death rate 5.1 per cent. Since the last named rate in the hospital at large is about 0.7 per cent (6), it would seem that the risk of birth for breech infants is increased at least seven times by the occurrence of such presentation.

Returning to Table IV one sees a strikingly consistent downward curve in gross mortality by weight groups to a minimum at  $7\frac{1}{2}$  to 8 pounds, interrupted by a paradoxical irregularity between the  $5\frac{1}{2}$  and the 7 pound groups, which may be due to an accidentally low mortality in the 6 pound, or an accidentally high mortality in the  $6\frac{1}{2}$  pound group. From the minimum gross mortality of 6.4 per cent among babies weighing from  $7\frac{1}{2}$  to 8 pounds, the mortality increases consistently in the groups above this level. Offhand one would suppose that the increasing size of the fetus would account for the increased risk on a mechanical basis, but in the highest weight groups, from  $9\frac{1}{2}$  pounds on, the recorded mortality is due more often than not to maceration, malformation, or to intercurrent causes.

*A general and comparative tabulation of gross fetal and neonatal mortality in breech born infants* Table VII is inserted at this point to show the gross antenatal, natal, and neonatal death rates in the breech series from 1913 through 1934, parallel with corresponding figures for all hospital deliveries from 1924 through 1934.<sup>1</sup> The strikingly higher incidence of stillbirths and neonatal deaths among breech born infants as contrasted with the occurrence of fatalities among the hospital newborn population at large is evident in both premature deliveries and immature and mature births.

<sup>1</sup>A statistician's delight in a smooth curve might be somewhat dampened by this finding, but he might find solace in a belief that if the 7 pound group, the mortality of which would then be 14.7 per cent, the regularity of the curve would be restored.

TABLE VI—GROSS NEONATAL MORTALITY AMONG PREMATURE BREECH BORN INFANTS, CONTRASTED WITH SIMILAR MORTALITY AMONG ALL PREMATURE INFANTS BORN IN THE HOSPITAL

Weight in pounds	1913-1934 Breech series			1923-1934 General series		
	Deliveries	Deaths	Mortality %	Deliveries	Deaths	Mortality %
Less than 1	0	0	0	1	1	100
1-1½	3	3	100	9	9	100
1½-2	10	10	100	33	32	97
2-2½	15	14	93.3	61	55	90
2½-3	23	19	82.6	84	58	69
3-3½	30	23	76.6	112	67	59.8
3½-4	31	11	35.4	143	46	32.2
4-4½	35	12	34.2	230	45	19.6
4½-5	32	8	25.0	262	29	11.1
	179	100	55.8	935	322	34.5

## THE EFFECT OF COMPLICATIONS OF PREGNANCY, LABOR, AND DELIVERY UPON MORTALITY AMONG BREECH BORN INFANTS

The figures so far recorded include all breech deliveries through the pelvis over a period of 22 years. It cannot be said that in all cases pregnancy and labor were normal so that the gross mortality among the infants born was due to the mechanics of birth, on the contrary 272 of the infants born were exposed, at some time, *in utero* or *intrapartum*, to one or several complicating factors which in themselves are generally recognized as dangerous to the life of the fetus before or during birth. Though these conditions, as they occurred, are recognized and will be recorded herewith, the number of cases occurring under each heading is in most instances too small to make a thorough analysis of the prematurity factor etc., worth while. However, it should be pointed out that when such a condition co-exists with breech presentation, the mortality risk should be compared not only with the risk incurred by an infant breech born of a mother free of such complication but also with the risk incurred by any infant born of a mother in whom such complication is present. Thus, the breech born infant of an eclamptic mother is subjected to the combined risks of maternal eclampsia and of breech de-

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TABLE VII.—GROSS ANTENATAL, NATAL, AND NEONATAL DEATHS IN BREACH DELIVERY CONTRASTED WITH ALL SUCH DEATHS OCCURRING IN THE HOSPITAL (EXPRESSED IN THE RATE PER THOUSAND BIRTHS)

	a) through 0.6	b) through 0.7	c) through 0.8	d) through 0.9	e) through 1.0	f) through 1.1	g) through 1.2
	20	20	20	20	20	20	20

Gross death		0 to 1 through 0 to 1	0 to 2 through 0 to 2	0 to 3 through 0 to 3	0 to 4 through 0 to 4	0 to 5 through 0 to 5	0 to 6 through 0 to 6
		0 to 1 through 0 to 1	0 to 2 through 0 to 2	0 to 3 through 0 to 3	0 to 4 through 0 to 4	0 to 5 through 0 to 5	0 to 6 through 0 to 6
Miscellaneous, premature and non-viable births	Hospital series	3.3	38.8	5	5	35	7
	Breath series			67	6	90	
Stillborn	Hospital series	74	45	35	5	8	7
	Breath series			7	6		
Premature infant and stillborn	Hospital series	5	65	5	7		9
	Breath series			6	7	7	75
Premature infant and stillborn	Hospital series		38				
	Breath series						
Immature and full term infant	Hospital series	74	6		75		53
	Breath series				6	38	53
Total birth	Hospital series		5				
	Breath series						

3 Chronic nephritis complicated with placenta previa and other abdominal lesions in syphilitic patients

every that born of a woman with placenta praevia runs the risk of death from both breech delivery and the effects of antepartum hemorrhage and asphyxia. For these reasons the complicated breech deliveries are arranged in Table VIII the analyses of separate complications are shown with the mortality in each.

1 Pre eclamptic toxemia alone was present in the mothers of 50% of the infants delivered. In other babies were born of toxemic patients in whom further complications occurred such as syphilis, pyelitis, cardiac disease, placenta previa, ablation of placenta and prolapse of the cord.

2 Eclampsia was a complication in 3 of the patients delivered.

Cases	%	Dec	Birth
1	100	100	100
2	100	100	100
3	100	100	100
4	100	100	100
5	100	100	100
6	100	100	100
7	100	100	100
8	100	100	100
9	100	100	100
10	100	100	100
11	100	100	100
12	100	100	100
13	100	100	100
14	100	100	100
15	100	100	100
16	100	100	100
17	100	100	100
18	100	100	100
19	100	100	100
20	100	100	100
21	100	100	100
22	100	100	100
23	100	100	100
24	100	100	100
25	100	100	100
26	100	100	100
27	100	100	100
28	100	100	100
29	100	100	100
30	100	100	100
31	100	100	100
32	100	100	100
33	100	100	100
34	100	100	100
35	100	100	100
36	100	100	100
37	100	100	100
38	100	100	100
39	100	100	100
40	100	100	100
41	100	100	100
42	100	100	100
43	100	100	100
44	100	100	100
45	100	100	100
46	100	100	100
47	100	100	100
48	100	100	100
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87	100	100	100
88	100	100	100
89	100	100	100
90	100	100	100
91	100	100	100
92	100	100	100
93	100	100	100
94	100	100	100
95	100	100	100
96	100	100	100
97	100	1	

[illegible]

3 Chronic nephritis complicated 16 deliveries in one other ablatio placentae was superimposed upon the kidney lesion

4 Eleven deliveries were in syphilis card ac disease was a compli  
In 12 deliveries additional card ac developed

4 Eleven deliveries were in symphysiotomy  
5 In 13 deliveries card ac disease was a complicating factor One additional card ac developed

6. Diabetes mellitus was present in 3 patients.

Hydramnios was present in 7 cases. In 6 cases it was associated with placenta praevia. In 1 case it was associated with placenta praevia and in addition to the cases here reported, it was associated with placenta praevia in 2 other patients. In 2 other patients it was associated with placenta praevia.

8 Ablatio placenta: in addition to the cases in which this condition occurred 27 times. In 2 other patients this condition was complicated by prolapse of the cord.

cord alone occurred in 20 cases.

9 Placenta previa alone  
10 Prolapse of the cord alone occurred in 17  
deliries miscellaneous complications occurred in 17  
thorax cystitis epilepsy

cases acute bronchitis chorea cystitis 1 each  
fibroid uterus hydronephrosis pentonitis 1  
bronchitis associated with cystitis 1 pyelitis 5  
pyelitis and cholecystitis 1 pulmonary tuber-  
culosis 3

The figures in Table VIII indicate that crude fetal and neonatal mortality in breech delivery occurring in pathological pregnancy or labor is from 33 per cent to 300 per cent higher than the gross mortality in breech delivery in general and that it is increased to between three and nine fold that occurring in uncomplicated delivery (cf Table VI). Since the various complications are represented by small groups and since they differ so fundamentally from each other the tabulation of crude mortality by years and by birth weights yields no significant information

TABLE IV—CRUDE MORTALITY IN COMPLICATED BREECH DELIVERY, AMONG PREMATURE, IMMATURE, AND MATURE INFANTS—INCIDENCE OF PREMATURITY

	Deliveries	Well	Stillborn	Died	Macerated	Malformation	Premature	Inter-current deaths	Mechanical deaths	Mortality %
Premature, by weight	106	21	46	39	10	2	33	22	9	80.1
Premature, unweighed	12	0	11	1	5	2	1	4	0	100.0
Immature by weight	42	32	5	5	3	1	0	5	3	23.5
Immature, unweighed	4	0	2	2	2	0	0	1	1	100.0
Mature by weight	106	78	18	10	4	4	0	5	15	20.4
Mature, unweighed	2	0	2	0	2	0	0	0	0	100.0
Total deliveries, by weight	254	131	69	54	26	7	33	30	27	48.4
Total deliveries, unweighed	18	0	15	3	9	2	1	5	1	100.0
Total deliveries	272	131	84	57	35	9	34	35	28	51.8

Incidence	By weight %	Total deliveries, %
Premature infants	41.7	43.3
Immature infants	16.5	16.9
Mature infants	41.7	39.7

other than that shown in Table IX, which summarizes the incidence of premature, immature, and mature deliveries and the crude mortality in each grade. The incidence of 43.3 per cent of premature infants in this group is to be expected, since not only do many of the complications, such as chronic nephritis and syphilis, predispose to premature labor, but others, such as toxemia and placenta prævia, often require termination of pregnancy a considerable time before term. Table X (7) shows that the dangerous complications of placenta prævia, ablatio placentæ, and prolapse of the cord are not only three, five, and five times, respectively, as frequently associated with breech presentation as with pregnancy and labor in general, but are also in each instance productive of a higher mortality among the newborn.

#### FETAL AND NEONATAL MORTALITY IN SIMPLE OR UNCOMPLICATED BREECH DELIVERY

The preceding paragraphs have demonstrated the tremendously increased risk to the infant in breech delivery in cases in which pathological pregnancy or labor co-exists. Analysis of 970, or 78.1 per cent, of the deliveries in this series, in which pregnancy and labor were free of the dangerous complications herein mentioned, indicates that crude mortality among the newborn was 18.5 per cent, a figure appreciably lower than the gross mortality among all deliveries. This group of

uncomplicated deliveries is presented in Table XI, which shows, in marked contrast to the figures from Table IX, that

1 The crude mortality in the group was 18.5 per cent

2 The incidence of premature infants was 15.7 per cent

3 Of the premature infants 62.1 per cent failed to survive

4 In the immature category 14.2 per cent were stillborn or died

5 Mature infants showed a crude mortality of 9.5 per cent

Table XII shows crude mortality among infants in this group by birth weights. The curve obtained is less regular than that shown in Table IV, but is in general similar to it, with the same sharp fall in mortality between the 3 and 3½ pound groups.

TABLE V—INCIDENCE OF PLACENTA PRÆVIA, ABLATIO PLACENTÆ, AND PROLAPSE OF THE CORD FOUND IN BREECH DELIVERY AND IN GENERAL

		Breech deliveries	Incidence %	Mortality %
Patients delivered with		All patients delivered		
Placenta prævia	22	1219	1.8	81.8
Ablatio placentæ	31	1219	2.5	74.2
Prolapse of the cord	29	1219	2.3	55.1

		General consecutive deliveries	Incidence %	Mortality %
Patients delivered with		All patients delivered		
Placenta prævia	2.5	39,135	0.33	37.9
Ablatio placentæ	1.5	40,731	0.47	61.5
Prolapse of the cord	3.55	67,701	0.40	40.0

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TABLE XI—CRUDE MORTALITY IN UNCOMPLICATED BREACH DELIVERY AMONG PREMATURE IMMATURE AND MATURE INFANTS—INCIDENCE OF PREMATURITY

	Delivered	Will	Still-born	Died	Macerated	Malformations	Premature	Enteric deaths	Mechanical deaths	Mortality
Premature, by weight		58		6					7	58.8
Premature, unweighed				3	6				7	100.4
Immature, by weight	3	90	7	7		4	3			
Immature, unweighed	4								36	80.9
Mature, by weight	706	643	34	9	7	8				100
Mature, unweighed	5		3		1					5.7
Maturity unrecorded unweighed							50	4	5	100
Total deliveries, by weight	95	79	6	97	7	4	58	6	5	5.8
Total deliveries, unweighed										
Total deliveries	7	79	79	100	8	6	58	6	5	5.8

By weight, "

4.7  
9  
74.3

Total deliveries "

5.7  
5  
73.5Incidence  
Premature infants  
Immature infants  
Mature infants

Crude mortality in uncomplicated breech delivery will be further discussed later in this article in its relation to corrected mortality in the same group of cases

## CORRECTED FETAL AND NEONATAL MORTALITY IN BREACH DELIVERY

In computing corrected statistics in a review of mortality the writer is forced to abandon the objectivity of reported figures for a more or less vulnerable position in which opinion must guide him in reaching his conclusions. The present paper is no exception to this rule. From this it follows that the corrected mortality figures of one observer may differ markedly from those of another due to a difference of premises in making the corrections. For example King and Gladden in computing their corrected mortality exclude cases of babies under 5 pounds macerated infants and multiple pregnancies. Caldwell and Studdiford in their report omit macerated infants and others under 4 pounds in weight. Taussig deducts macerated fetus premature infants twins and malformations in arriving at his conclusions but includes one death complicated by prolapsed cord in a case delivered of a pre-eclamptic mother and another complicated by abruption placenta. Mohler in computing a traumatic death rate in breech delivery excludes infants under 3

pounds premature and macerated infants and certain others over 3 pounds in weight. Morton assumes 1500 grams or 3 pounds 5 ounces as the lower limit of viability in the newborn child and includes only babies above that level in reporting his series. He calls attention however to the difference in prognosis for viable infants below and above 2500 grams or 5 pounds 8 ounces. Cannell and Dodds who include 13 cases delivered by cesarean section in a series of 562 breech infants exclude premature infants under 5 pounds 8 ounces malformations and macerated fetus in correcting their gross figures.

This brief summary of methods of correcting gross mortality figures used by various American authors indicates that their respective statistics are not founded upon any common denominator and hence are not strictly comparable. The present article at least suggests a common denominator not only by separating the pathological from the uncomplicated pregnancies and labors but also by separating the premature from the immature and mature infants delivered. Any interested reader who may be so inclined provided only that he use the English rather than the metric system of birth weights will find in the accompanying text and tables ample material which he may use to compare with his own figures.







TABLE XIII.—CRUDE AND CORRECTED MORTALITY IN UNCOMPLICATED BREECH DELIVERY (MATURE INFANTS)

	Deliv-eries	Wt.	Stillborn	Died	Mor-tal	Mal-forma-tion	Pre-ma-ture	Inter-current deaths	Mechan-ical deaths	Crude mortality %	Corrected mortality %
93	5(p)	00	25	6	2			0	5	7	4
93(p)	93(p)	00	28	8				3	2		
93(p)-93(p)		07	0	4	3			3	6	3	0.3
93(p)	93(p)	00	20	3	2				8	1	
93(p)-93(p)		00	0	2	3	4			1	8	
93(p)	93(p)	00	01	4	3				3	2	2.1
93(p)	93(p)	00	1	3					3	2	2
	7	1	0						16	1	8

TABLE XIV.—CRUDE AND CORRECTED MORTALITY IN UNCOMPLICATED BREECH DELIVERY (MATURE INFANTS)

Primiparous Single Pregnancies

	Deliv-eries	Wt.	Stillborn	Died	Mor-tal	Mal-forma-tion	Pre-mature	Inter-current deaths	Mechan-ical deaths	Crude mortality %	Corrected mortality %
93	93(p)	00	25	9	6					15	4
93(p)-93(p)		00	05	3						2	5
93(p)-93(p)		3	8	4		1			3	4.4	2.8
	33	55	3			1		3	7	8.6	6.5

TABLE XV.—CRUDE AND CORRECTED MORTALITY IN UNCOMPLICATED BREECH DELIVERY (MATURE INFANTS)

Multiparous Single Pregnancies

	Deliv-eries	Wt.	Stillborn	Died	Mor-tal	Mal-forma-tion	Pre-mature	Inter-current deaths	Mechan-ical deaths	Crude mortality %	Corrected mortality %
93	93(p)	25		7				6	8	7	
93(p)	93(p)	0	4	3				3	3	9	8
93(p)	93	58	48	4	4				6	7.5	2.9
	8			6	7	2			7	5	7.5

same finding and have accounted for it by stating that multiparae are more apt to give birth to large and overdeveloped infants. Our figures show that multiparous single pregnancies resulted in the birth of 42.4 per cent of mature infants weighing over 8 pounds whereas of mature infants born of primiparae only 25.5 per cent occurred in the higher weight groups of 8 pound and above. Of these however the corrected mortality among heavy first born babies proved to be 10.1 per cent while that among babies born of multiparae was 7.7 per cent. The factor of over development in this series therefore did not

account for the greater mortality in mature infants born by multiparous delivery.

Tables XVI and XVII show primiparous and multiparous single deliveries respectively recorded when possible in blocks of 100 with the crude and corrected mortality in each block. Again as in Table XIV the trend of mortality in recent years has been downward.

Crude and corrected mortality in immature and mature infants born by uncomplicated breech delivery. The final groups to be analyzed in this survey are the series of immature and mature infants born near or at term by uncomplicated breech delivery. The latter



are the cases which correspond most closely to those reported by other authors in their statistics of corrected mortality, although some by definition include infants classed in this study as immature. We have seen, in Table XI, that infants weighing between 5 and 6 pounds are subject to a crude mortality of 14.2 per cent, and that 9.5 per cent of mature newborns fail to survive. Table XIII shows a corrected mortality of 10 per cent for immature, and 6.9 per cent for mature, infants.

In Table XVIII the mature infants in this series are arranged, so far as possible, in blocks of 100, to represent the trend of mortality during the 22 years surveyed. Once again the improvement in results of recent years is impressive.

The same block arrangement of deliveries is shown in Tables XIX and XX for primiparous and multiparous single pregnancies.<sup>1</sup>

To summarize, therefore, the mortality figures for immature and mature infants born by uncomplicated breech delivery, we find that

1 Of 816 such newborns, above 5 pounds in weight at birth, 83 were stillborn or died, a crude mortality rate of 10.1 per cent, excluding the deliveries of macerated and grossly malformed infants, the corrected mortality was 7.3 per cent.

a Babies weighing more than 5 but less than 6 pounds at birth showed a crude mortality of 14.2 per cent, and a corrected mortality of 10 per cent.

b Mature infants over 6 pounds at birth yielded a crude mortality of 9.5 per cent, and a corrected stillbirth and death rate of 6.9 per cent.

2 The mortality rates among mature single infants, both crude and corrected, have shown a marked decline during the years surveyed.

#### SUMMARY AND CONCLUSIONS

1 A review of 1,242 breech deliveries in the Boston Lying In Hospital, beginning with the year 1913 and ending with the year 1934, is presented.

2 The gross combined fetal (stillbirth) and neonatal death rate was 25.7 per cent.

3 It was found that in 272 deliveries, or 21.9 per cent of the total, either the pregnancy was pathological, with such complica-

tions as pre-eclamptic toxemia, eclampsia, nephritis, syphilis, diabetes hydramnios, etc., or labor was complicated by such conditions as placenta prævia, ablatio placenta, or prolapse of the cord. Since the crude mortality in this group was 51.8 per cent, the effect of pathological pregnancy and labor as an important factor in the high gross mortality is evident.

4 In the 970 deliveries uncomplicated by pathological pregnancy or labor as above defined the crude mortality was 18.5 per cent.

5 Prematurity of the infant was common in both groups and contributed in no small measure to the crude mortality in each. Uncomplicated deliveries produced premature infants in 15.7 per cent of the cases, with a crude mortality rate of 62.1 per cent, pathological pregnancies and labors resulted in the birth of 43.3 per cent of premature infants, with a crude mortality rate of 82.2 per cent.

6 The risk of breech delivery *per se* should be computed only from cases in which uncomplicated labor occurs. Nevertheless it should be borne in mind that this series shows the incidence of placenta prævia, ablatio placenta, and prolapse of the cord to be respectively three, five, and five times as frequently associated with breech presentation as with all types of delivery.

7 In uncomplicated breech delivery the crude mortality resulting from primiparous single pregnancy was 18.1 per cent, from multiparous single, 17.2 per cent, from primiparous multiple, 24.3 per cent, and from multiparous multiple, 23.8 per cent.

8 In correcting the crude mortality figures in this series, the only cases excluded are those resulting in the birth of macerated infants and grossly malformed babies. Using this standard for uncomplicated breech delivery, we find that the corrected mortality was 13.6 per cent among 916 newborns, subdivided as follows: 53.6 per cent for premature, 10 per cent for immature, and 6.9 per cent for mature infants.

9 The mortality figure of 6.9 per cent, therefore, represents the risk to the living, undeformed, full term infant *in utero* who is destined to be born by pelvic breech delivery in the absence of pathological pregnancy on

<sup>1</sup>The infants born of multiple pregnancies are too small in number to make this type of analysis of value, but the corresponding information may be obtained in Table XV.

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the part of the mother and of hemorrhagic  
 and other accidents of labor due to abnormal  
 ities of the placenta or of the umbilical cord

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## ON THE DIFFERENT FORMS OF NON-GENERALIZED FIBROUS OSTEODYSTROPHY

THE LOCALIZED, THE DIFFUSE MONOSTOTIC, THE UNILATERAL AND THE MONOMELIC FORM

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THE question of localized (non-generalized) osteitis fibrosa is still very enigmatic despite the fact that during the last two decades a great number of investigators have tried to arrive at greater clearness. From the pathologic-histological viewpoint the question is relatively simple in the more common cases, but a conclusive diagnosis is by far not always to be made merely on the basis of the microscopic study of a few slides. The histological picture of osteitis fibrosa is a too frequent response of bone marrow to different damages and stimuli. It may occur in a number of essentially different bony diseases, as inflammatory, neoplastic, metabolic, and simple mechanical disturbances, so that the histological diagnosis of osteitis fibrosa quite often may in the special case be more obscuring than clearing up. In a great number of cases it is only a symptomatic but not a nosological diagnosis.

Nevertheless, there is no doubt that a great deal was done by investigation of pathology, and the recognition of localized osteitis fibrosa in all its forms as an essentially benign lesion signifies a great accomplishment. This seems to be especially true for the giant cell tumors or brown tumors which nowadays are considered by the greater number of pathologists as granulomas rather than real neoplasms. According to Lubarsch and many others, they develop following extensive hemorrhage in the bone marrow. The resorption and organization of the hematoma occur with development of non-specific granulation tissue, which may assume tumor-like appearance. Similarly, the cystic forms of osteitis fibrosa have been explained also on the basis of an extensive hemorrhage in the bone marrow, leading to increased pressure within the marrow spaces and impairment of the blood circulation, especially of the venous flow, von Recklinghausen's

stage of phlegmasia, again newly introduced by Pommer as an important factor in bone pathology. Bone tissue yields to this augmentation of pressure with osteoclastic resorption and, by hydropic degeneration of the fibrous bone marrow, bone cysts may develop.

Clinical observations seem to speak in favor of the just mentioned interpretation because of the relatively frequent observation of spontaneous healing of bone cysts and because of the good response to surgery and X-ray treatment. Thus, we quite often find the topic of localized osteitis fibrosa treated in textbooks of surgery with great confidence and optimism as far as treatment and prognosis are concerned. Nevertheless, every surgeon of some experience with cases of localized osteitis fibrosa knows that such cases do not always do as well as one would expect from the textbook descriptions. Local recurrences are quite frequent and functional impairment of the affected extremity is by no means rare. This is especially true for the group of giant cell tumors, which in many respects act quite differently from simple cases of osteitis fibrosa.

For this discrepancy between textbook optimism and greater reservation in practice we thought it worth while to look over the material of localized osteitis fibrosa as it came to observation in the Surgical and Orthopedic Departments of the State University of Iowa.

We do not intend to give here a detailed study of the pathological findings, although a good number of the cases presented have come to histological examination. Neither can it be of greater interest to discuss more extensively the X-ray findings. This has already been done too frequently and a good number of excellent articles are available. Our main task is the classification of the different lesions. It was planned to present the entire material in one paper, for external reasons, however, the giant cell tumors will be reported separately.



November 9, 1933      June 8, 1934      October 8, 1934

Fig. Cases 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

We have divided our material of 25 cases into 4 groups

A Cystic and solid localized lesions of osteitis fibrosa 18 cases

B Multiple localized lesions 2 cases

C Diffuse monostotic lesions 2 cases

D Osteodystrophia fibrosa unilateralis 3 cases

#### GROUP A CYSTIC AND SOLID LOCALIZED LESIONS OF OSTEITIS FIBROSA

In group A the cystic and solid localized lesions of osteitis fibrosa there were 18 cases, 9 males, 9 females. The ages ranged from 2½ to 42 years, the average being 11½ years.

First died of life  
Second died of life  
Third died of life  
Fourth died of life  
Fifth died of life

Cases  
3

#### CASUISTICS ACCORDING TO LOCALIZATION

##### Upper Metaphysis of the Humerus—4 Cases

CASE 1 Sixteen year old boy who 3 weeks before admission while playing ball felt a snap in the right shoulder and could not use his arm after that. X-ray pictures showed a cystic destruction in the upper metaphysis of the humerus and a pathological fracture with good callus formation. No follow up.

CASE 2 Eight year old boy fell 4 months before admission a distance of some paces on the right arm which cleared up soon. Three weeks before admission he slipped and fell forward on his arm. There was a sudden moderate pain with disability. X-ray pictures showed a bony cystic area on the upper metaphysis of the humerus the cortex was broken through in one place and reinforced by penosteal bone signs of a healing pathological fracture. At

operation on the cyst in the humerus was found filled with brownish gelatinous material of the appearance of an older blood clot. The cyst walls formed by a layer of granulation tissue varying in thickness. Careful curetting was carried out the wound was cauterized with 95 per cent phenol and vaseline strips and shoulder spica were applied.

One year after operation there was free motion in the shoulder joint and strength in the right arm was coming back. Patient was clinically improved. X-ray pictures at three different occasions showed that after curetting the cyst gradually became smaller the cortex became stronger but there still remained a very big cavity and it seemed doubtful whether it would ever fill in entirely.

CASE 3 Eleven year old boy had quick bony consolidation after fracture of the right humerus 2½ years before admission. Two years previously he fell and fractured the right humerus. X-ray pictures showed a multilocular cystic lesion in the upper metaphysis of the right humerus with widening of the shaft and thinning of the cortex from within. Patient was submitted to X-ray treatment (five series within 1 year). The roentgenograms taken at different stages of the X-ray treatment show gradual improvement with better calcification the cystic areas are filling in and the cortex is becoming stronger the shaft getting more and more straight.

CASE 4 A boy 7 years old had a fracture of the left humerus 15 months before admission—right injury. Fracture was reduced and immobilized for 6 weeks. Healing was good. The day of admission patient fell again on his shoulder and re-fractured the humerus.

Patient brought the roentgenograms taken at time of first injury which showed a typical picture of a sharply outlined cystic area in the upper metaphysis of the humerus and a recent transverse fracture through the cystic area. Nine months later the cyst had increased to the length of 2 inches. There was good union of the original fracture and began organizing the cyst by bony trabeculation.

At time of admission on a fresh superior osteal fracture could be seen running through the cystic area with lateral angulation of the fragments. Patient was immobilized in shoulder spica. One year later excellent healing with good correction of the deformity was present. The cystic area had entirely disappeared and there was only a slight irregularity of the bony structure.

CASE 5 A boy 10 years old had a fracture of the right humerus 1½ years before admission. The fracture was reduced and immobilized. The first fracture was followed by necrosis in size of the cyst the second by excellent healing.

##### Upper Metaphysis of the Femur—8 Cases

CASE 6 Twenty six year old woman for 4 years dull and aching pain as noted in left hip as well as muscle pain. X-ray pictures showed a cyst in the region of the greater trochanter well outlined and of the size of a 25 cent piece. Hip was im-

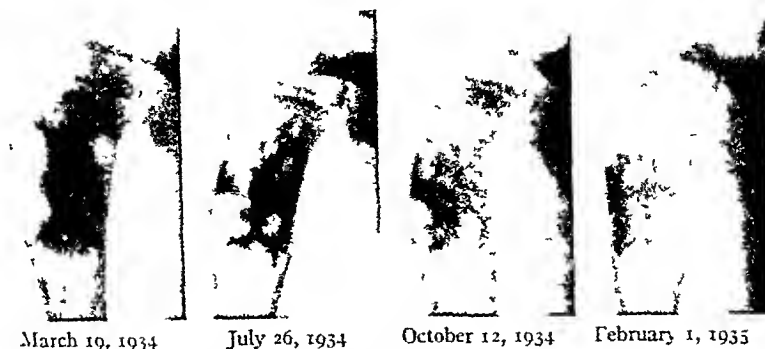


Fig. 2 Case 3 Boy, 11 years old Cystic lesion of upper metaphysis of humerus, with considerable improvement under X-ray therapy

mobilized in a plaster cast. Four months later the cyst was filling in, 2 years later the roentgenograms revealed normal conditions, with no cystic area.

**CASE 6** In 11 year old boy had limp and pain in the right groin for 9 months. The X-ray picture showed a cyst in the neck and the upper end of the shaft with incomplete fracture. The parents refused to have the child operated upon and a hip spica cast was applied. Seven years later patient was feeling all right. He had no pain, hip motion was limited, and there was some limp. No roentgenological check-up was made.

**CASE 7** A 2½ year old girl had limped for 1 month following a fall. The X-ray picture showed a cystic area occupying almost the entire neck of the femur with some periosteal bone production, especially on the outside of the metaphysis. A long hip spica cast was applied. Six months later the cyst had enlarged and the bone was definitely blown up. There was no break in the cortex. One year later (2 years after injury), good healing had taken place with better calcification and a coarse system of new bony trabeculae.



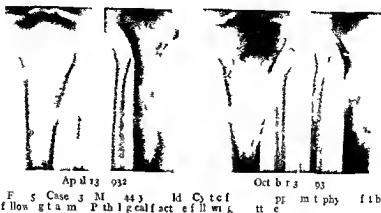
Fig. 3 Case 4 Boy 7 years old Pathological fracture through cystic lesion in upper metaphysis of humerus. Good healing under conservative treatment

**CASE 8** A 10 year old girl had a fracture of the upper third of the femur, at which site she had had a fracture before. X-ray pictures showed a big cystic area in the upper end of the diaphysis with pathological fracture and marked varus deformity. There was inward displacement of a piece of the inner cortex. The cortical bone on the outer side was very thin. A double hip spica cast was applied. X-ray pictures, 3 months later, showed good bony healing with filling in of the cavity and a good deal of the deformity corrected. One year later patient started to limp again. Roentgenograms revealed slipped epiphysis.

**CASE 9** A woman 28 years of age, 5 months before admission, while doing ordinary housework, began to limp. Motion in hip and knee was quite painful. Immobilization in cast and bed rest were maintained for 5 weeks. X-ray pictures at admission showed a very extensive destructive lesion in the upper end of the femur with extension into the head. There was a pathological fracture through the neck with marked coxa vara deformity. The cortex was thinned, but was not broken through. There was no periosteal bone formation. A hip spica cast was applied. Roentgenograms 1 year later showed good bony union at the site of the fracture. There was better calcification in the cystic area.



Fig. 4 Case 7 Girl 2½ years old Cystic lesion in upper metaphysis of femur. Good healing under conservative treatment



**CASE 10** A 12 year old boy had a fracture of the right femur 3 months before admission to the hospital. Six years previously he had had a fracture at the same site which healed perfectly. Roentgenograms showed a large multilocular cystic lesion in the upper third of the femoral shaft with marked varus deformity. A subtrochanteric osteotomy was performed to correct the varus deformity. Six months later good alignment was present with increased density of the cystic area as a sign of healing tendency.

**CASE 11** A 5 year old boy had had a lump and slight limitation of motion in the right hip for the last 3 weeks. Roentgenograms showed a big cyst in the upper end of the femur 1 to 1.5 inches in diameter. At operation a large cyst of the size of a hen's egg was opened below the greater trochanter, scraped and cleansed with tincture of iodine and alcohol. A plaster cast was applied. Recovery was uneventful. Patient was seen again 5 years later when he had no shortening, no limitation of motion—clinically perfect result. No X-ray check up was made.

**CASE 12** A 6 year old boy had had a lump for 2 months. Roentgenograms showed a 1 inch long cystic lesion in the middle and lower part of the neck of the femur. No pathological fracture was noted. At operation the cyst was opened. The walls were covered by soft granulation tissue which was carefully scraped out. An iodoform drain was inserted and a cast applied. Roentgenograms 6 months later showed good healing, the cavity being almost filled in. No further follow up has been made.

#### Upper End of the Tibia—Cases

**CASE 13** Patient aged 44 years, male, 8 months before admission received a severe blow over the upper end of the tibia from a pickaxe. The skin was broken but the bone was not exposed. The wound healed quickly but quite a marked pain in this region persisted. Weight loss as 2 pounds. Roentgenograms showed an extensive destructive lesion purely osteoclastic involving the upper end of the tibia

with destruction of the anterior cortex. There was practically no periosteal bone production.

At operation a cavity was found in the upper end of the tibia filled with rather soft grayish white tissue which could easily be peeled from the adjacent normal bone. Thorough curetting was done and a plaster cast was applied. Pathological report: osteitis fibrosa.

Following operation patient was able to walk with some difficulty and pain persisted. He gained 10 pounds. Six months later he fell and fractured the leg at the site of the cystic lesion. X-ray pictures revealed further extension of the lesion and a fine transverse fracture line. Patient insisted upon amputation which was performed.

**CASE 14** An 8 year old girl had some pain and limp of right leg following direct trauma to the right tibia 2 months ago. Roentgenograms a short time after the injury showed a small fracture. A few months later a cystic lesion in the upper end of the tibia at the site of previous fracture. Roentgenograms at admission showed a slightly lobulated cystic area in the upper metaphysis of the tibia surrounded by some sclerosed bone tissue. Periosteal bone production (callus formation) was also noted.

At operation the bone cyst was found filled with a yellowish brown cellular matrix. The area was thoroughly irrigated 95 per cent phenol alcohol and a cellulose plaster splint applied. Brodie's abscess which had to be considered especially from the roentgenological viewpoint could be ruled out by histological and bacteriological examination.

#### Lower End of the Tibia—Case

**CASE 15** A 7 year old boy 10 years previously had had a severe trauma to the left foot and could not walk for months. During the following 2 years walking was very much impaired and there were some draining sinuses. Six months ago he twisted his foot and immediately after he could not walk. The ankle was swollen and painful. Bed rest was maintained for 2 weeks. Roentgenograms showed a clear cystic area of the site of a goose egg 1 1/2 in.



factor we would expect to find diaphyseal lesions more often

All the cases presented have been verified by histological examination as far as they came to operation. Cystic and solid forms were considered under the same group of localized osteitis fibrosa and this difference in morphological appearance has been taken only as one of degree. In quite a number of cases a variable amount of giant cells was present in sections but we did not think that their irregular distribution and relative scarceness compared with the fibrous tissue which dominated the picture would justify the term giant cell tumor. It is known however that there may be fluent passages from osteitis fibrosa to giant cell tumor as far as the histological picture is concerned.

An important question in cases of localized osteitis fibrosa is the significance of trauma. It is known how difficult it is to rule out definitely traumatic etiology in any skeletal lesion especially in childhood. For a number of osteitis fibrosa cases however trauma seems to have more than accidental importance. At least from the clinical viewpoint there is no doubt that a great number of cases come to clinical observation following trauma. Quite often however the trauma mentioned in the history is insignificant but it may lead easily to infraction or complete fracture of the diseased area. If roentgenograms are taken at this time the fracture is evidently pathological; it runs through a cystic area of the skeleton. The bone cysts must have developed insidiously for some length of time previous to the fracture which led to the clinical recognition of the lesion. The pathological fracture has therefore no etiological importance for the development of the bone cyst. It is a secondary complication and not a primary causative factor. However there are quite a number of cases in which definite trauma preceded the occurrence of recognized pathological fracture for some time. In cases of repeated fractures at the same localization especially in which the roentgenograms at the time of first fracture did not reveal pathological condition of the broken bone it is quite possible that the first fracture may have led to an extensive hematoma of the bone marrow, the

organization of which resulted in cyst formation.

In our series of 18 cases pathological fracture at time of admission to the hospital was present in 11 (Cases 1, 2, 3, 4, 6, 8, 9, 10, 13, 16, 18). Five out of these had 2 fractures at the same site (Cases 3, 4, 8, 10, 18) and 1 (Case 16) even 3 but in 3 of these cases there is doubt whether the first fracture can be considered as pathological in the absence of definite X-ray findings at that time. The occurrence of the second fracture at the same site suggests however a causal connection which most likely is represented by the bone cysts developing after the first fracture. Definite X-ray evidence that the cyst developed 1 month after fracture through the upper metaphysis of the tibia we find in Case 14. Severe trauma although not leading to fracture was also present in Cases 13 and 15 and we have reason to believe that in these cases trauma is of primary importance for the formation of a bone cyst.

The 8 cases which did not show definite signs of fracture at the time of admission were complaining of weakness with limp if the lower extremity was involved. And as a rule the symptoms became manifest after a fall. Weakness of the affected bones, pathological fracture and limp are therefore the most important among the early clinical symptoms of localized osteitis fibrosa. Pain as a rule is due to the pathological fracture and irritation of periosteum but not to the disease itself.

The question arises as to the curative importance of the pathological fracture in bone cyst. It is a frequent statement especially in the German literature that bone cysts heal after pathological fracture. The explanation given is that the fracture leads to decreased pressure within the cyst. This statement is based partly upon clinical observation partly however upon the assumption that bone cysts derive from bone resorption following increased intermedullary pressure caused by an extensive hematoma.

In our group there are 7 cases with pathological fracture in which only conservative treatment was followed (Cases 1, 4, 6, 8, 9, 10, 16). One (Case 1) is entirely without follow up in 3 instances (Cases 4, 6, 8, 9, 10) definite





Fig 7 Case 17 Girl, 10 years old. Multiloculated cystic lesion of tibia diaphysis, involving the anterior cortex. Anteroposterior and lateral views.

improvement could be noticed following the fracture with increased calcification of the diseased areas in the roentgenograms. Case 4, especially, showed perfect healing of the cyst cavity following the second pathological fracture. One case (Case 16), with two re-fractures, showed good fracture healing. But 4 years after the last fracture, swelling re-appeared and, although roentgenograms were not taken, the patient's description is very suggestive of an increase in size of the bone cyst. So, of 6 cases, apparently only 1 was not improved by the fracture, on the contrary, it showed increase in size of the bone cyst. It is true, however, that the observation time of the 4 cases which showed improvement is relatively short. Only 1 case (Case 6) is followed up for 7 years following first admission, in all the other cases the last control examination was around 1 year after the fracture. Therefore, we can conclude only that the occurrence of pathological fractures in bone cysts may lead to improvement and in some cases even to permanent cure, but we are on the basis of our material, not able to give any definite statement as to how often a pathological fracture is followed by permanent healing of a bone cyst.



Fig 8 Case 18 Girl, 2 1/2 years old. Diaphyseal lesion, involving the cortex. Anteroposterior and lateral views.

The improvement following fracture can be explained by two factors, the one already mentioned is a decreased pressure with its bone resorbing effect, the other is a stimulus to osteogenesis and callus formation, leading to better calcification and the appearance of coarse trabeculation in the roentgenograms.

If this is true and if the pathological fracture in itself has a good influence upon the healing process of bone cysts then, of course, we have to expect even more from surgical interference.

Of 18 cases 8 were treated surgically, the procedure usually consisting in cutting a window in the thinned cortex and in scraping or curetting out the cavity as thoroughly as possible. Then the cavity is swept out with 95 per cent phenol or iodine tincture and alcohol. In 1 patient (Case 15) bone chips were used from the same bone (tibia) to stimulate bone formation. Two cases have to be ruled out because of lack of control examination following operation. One patient (Case 11) made a good and lasting recovery (5 year observation) following scraping of a cyst in the upper end of the femur. In another case (Case 12) in which the cyst wall was likewise scraped the

cavity was almost entirely filled by bone tissue 7 months following operation. In Case 2 with 1 year of observation there are some signs of improvement but the cavity is still very big and does not show a more marked tendency of getting smaller.

Very definite is the improvement in Case 15 in which after the scraping of the big cyst in the lower end of the tibia a good number of bone chips were used to fill the cavity. In this case 18 months after operation there was such marked improvement clinically and roentgenologically that permanent cure can safely be expected. The sequestration of a number of bone chip a short time after operation did not interfere with the result.

There remain 2 cases (Cases 13 and 18) with decidedly poor results. In Case 13 patient sustained a pathological fracture following curettage of the cystic area in the upper end of the tibia which 6 months after the operation did not show any healing tendency. Patient insisted upon amputation. The other case a diaphyseal cyst of the tibia in a young child of 2½ years showed progression despite the occurrence of a pathological fracture. The radical curettage was followed by recurrence within 2 months. A second thorough curettage was performed but the child did not return to the clinic for further check up.

Of the 6 cases treated surgically 4 showed improvement (observation time varied from 7 months to 5 years following operation) 1 patient (Case 2) 1 year observation showed clinical improvement but the roentgenograms still revealed a big cystic area. Two cases (Cases 13, 18) had to be considered failures.

In Case 18 it is true we do not know how the second operation came out. The first one however was very rapidly followed by recurrence. This case we think has certainly a tendency to local malignancy. It seems to belong to a certain group of cases in which the bone cyst is filled with solid tissue it is therefore not a real but a pseudo cyst. This group can best be termed borderline cases to malignancy. They are more frequently observed with giant cell tumors. We shall discuss this group later more in detail.

Somewhat different is Case 13. In this man of 44 years it is very likely that the severe

trauma to the upper end of the tibia resulted in traumatic necrosis of the bone followed by bone resorption and cyst like appearance. The thorough curettage weakened the bone even more and so there is no wonder that a fracture occurred in the weakened weight bearing bone. The leg was amputated despite the fact that there were no definite signs of local recurrence or more marked extension. Decisive was the patient's desire to get back to work as quickly as possible.

The good result obtained in Case 15 in which a large cyst showed very fast and good healing after curettage and grafting of bone chips the very slow healing in Case 2 and the failure in Case 13 suggest very strongly that the filling of the scraped cavity with transplanted bone is the treatment of choice. Especially in greater cavities and in older individuals in whom the power of osteogenesis has become lowered it seems that we cannot expect a complete bony obliteration of the cystic defect by spontaneous bone production. This seems as we shall see to be even more so in the group of giant cell tumors.

In 1 case (Case 3) instead of surgery X ray treatment was followed. Very definite improvement could be seen within 1 year. Although there is a pathological fracture in the history it seems that the healing process has entirely to be attributed to the irradiation because 4 months elapsed without improvement between fracture and first X ray treatment. One case is of course not enough to draw any conclusions but it seems that X ray treatment can be used quite advantageously in a number of cases of bone cysts.

Finally 2 cases have to be mentioned (Cases 1 and 3) in which healing occurred without any manifest pathological fractures or any special treatment besides immobilization in plaster casts. One case (Case 3) 2 years after admission to the clinic showed good filling in of the bone cysts the other 2½ years after admission does not reveal any pathological structure in the roentgenograms. These 2 cases prove that spontaneous healing of bone cysts is possible with *restitutio ad integrum* of the bony structure but it is certainly rare. It can however not be ruled out that some small fractures which could not be rec-

ognized roentgenologically were present in these cases

The 18 cases presented were typical inasmuch as they showed a localized lesion of the skeleton in the sense of cystic or solid fibrous osteitis. In quite a number of these cases the X-ray pictures of other portions of the skeleton were taken but did not reveal any pathology. We found, however, in our material 6 cases which do not fit entirely into the group of localized osteitis fibrosa or belong to the generalized form. From a study of the literature, it does not seem possible that a true case of localized osteitis fibrosa ever changes to a generalized form in the sense of von Recklinghausen. There is one case reported by Bergmann, a case of localized osteitis fibrosa, which at the age of 8 years healed well. Thirteen years later, however, the patient developed besides a local recurrence a typical picture of generalized fibrocystic disease.<sup>1</sup> It seems to us, however, that this is only by coincidence and there is no proof that the generalized form developed from the localized one. From the following cases, it will appear that between the monoseous, sharply localized cases and the generalized forms with all the characteristic changes in calcium metabolism we have cases with several similar lesions in the skeleton, each of them well localized, then cases in which one bone of the skeleton is extensively involved, and, finally, cases with a strictly unilateral distribution following certain anatomical structures. However, all of these cases with more extensive involvement of the skeleton do not represent stages of passage to the generalized form. They are typical of the normal blood chemistry and there is nothing to suggest an endocrine disorder.

#### GROUP B MULTIPLE LOCALIZED LESIONS

CASE 19 A girl, 12 years of age, had a stabbing pain in the right arm for last 10 months. The roentgenograms showed a multilocular cystic lesion in the lower half of the right humerus with thinning of the cortex and blowing up of the shaft.

At operation, the bony cavities were found filled with solid parts of granulated material and some cystic areas were present. The area was curetted. Two heavy tibial bone grafts were used to fill the

defect. X-ray pictures following operation showed a heavy inlay and onlay graft, but the cavity was not filled in entirely. A picture of the tibia from the area from which the bone graft was removed showed good regeneration 2 months following operation. An accidental finding was a small cystic area in the lower metaphysis of the tibia, involving the inner cortex. This cyst was not in relation to the bony defect.

Six months after the first operation, the cystic area of the tibia was exposed. The cyst was well curetted and filled with bone chips. X-ray pictures 15 months after the first operation showed the bone grafts well assimilated to the humerus. The cystic lesion was improved but not healed. There were still some cystic areas present. The cystic lesion in the lower end of the tibia was still present.

X-ray pictures taken at different occasions (from 2 to 5 years after first operation) always showed the same changes. The lesions in the humerus and tibia seemed to be stationary. Pictures of all bones of the skeleton were taken and another small cyst was found in the outer cortex of the left femur at the junction of middle and lower thirds. Clinically, the patient felt fine, only she had occasional pain in the right ankle. The blood chemistry revealed normal values.

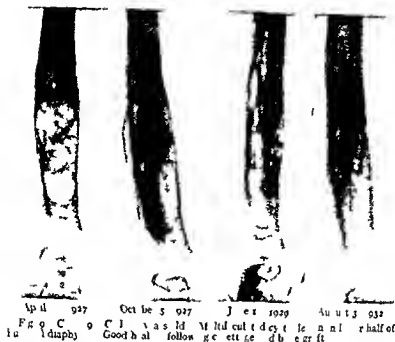
CASE 20 A patient 1½ years old, female, had a slight limp of the right leg for the last 4 months. Patient fell the day before admission and hurt her right leg, with marked aggravation of symptoms. Roentgenograms showed to a considerable extent at the junction of middle and lower thirds of the tibia and, a little lower, of the fibula an irregular cystic area with periosteal reaction and reactive bone production around the cystic areas. Similar changes were also present in the upper third of the tibia, especially where the inner posterior cortex was involved. There was anterior and valgus bowing of the tibia.

Patient was given a short leg cast. She returned 4 months later. Laboratory work was essentially negative (tuberculin test, Wassermann reaction, and blood chemistry). Biopsy from tibia showed osteitis fibrosa.

The valgus bowing of the tibia rapidly became worse under the weight bearing stress, despite the brace. The leg was therefore manipulated under anesthesia, and a long leg cast was applied. Roentgenograms 6 months after first admission showed that the lesion had progressed in the lower part of the tibia where a definite cystic area with increased valgus deformity could be seen, following pathological greenstick fracture. At the site of this pathological fracture between middle and lower thirds of tibia a definite pseudarthrosis developed. Considerable periosteal reaction was present, probably due to the fracture (callus formation).

Operation was done 10 months after first admission. Exploration of the site of the deformity revealed pseudarthrosis with fibrocartilaginous tissue interposed between the bony ends, Beck's drilling,

<sup>1</sup>Bergmann E. Von der lokalisierten zur generalisierten Osteitis fibrosa. Arch f. Klin. Chir., 1920, 141: 673.



correct on of deformity. A cast was applied and later was changed to brace.

Patient was seen at several occasions. She walked with a limp but without pain. She had no complaints except an increase of the valgus deformity of the right leg which is definitely longer than the left. Extensive curettage with massive bone graft from the other tibia was considered.

Some of the roentgenograms in the last case were somewhat suggestive of a connection between the two lesions in the tibia in the sense that there was not a double lesion separated by normal bony tissue but only one extending almost through the entire diaphysis. Without doubt such an extensive bony involvement was present in the two following cases which at first impression seemed to be simple case of localized osteitis fibrosa. The findings at time of operation however and the slowly but constantly progressive character of the lesion leading to an extensive invasion of the marrow cavity pointed toward a separate position among the cases of osteitis fibrosa.

#### GROUP C OSTEITIS FIBROSA DIFFUSA MO OSTOITICA

CASE 2. A girl aged 10 years complained of an increasing lump during the last year. The lump started following trauma to the right hip when she

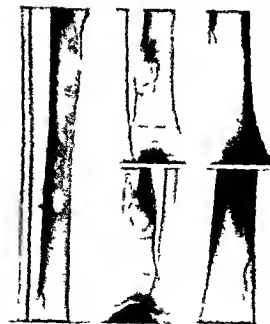


Fig 10 S m c a s h g r e m s c r i b e d y s t l e t h t e t f t h t b i a f m l h t h b o g a f t h s b e n r m d ( ) f S a m e l f t c t t g A c c d t a l f d f c t a l y t l o f m

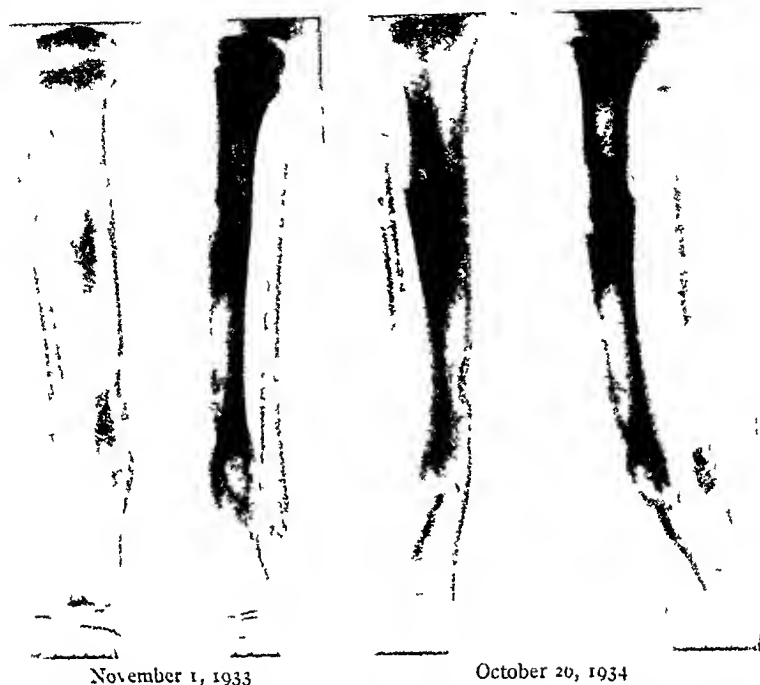


Fig 11 Case 20 Girl, 1½ years old Cystic lesion at junctions of upper and middle, and of middle and lower thirds of tibia, and in lower third of fibula Pseudarthrosis following fracture

fell from a sled Roentgenograms showed a large cystic area in the upper end of the shaft of the femur with irregular, mottled structure in the subtrochanteric region, more purely osteoporotic in the neck. The proximal margin of the lesion was quite sharp distally it gradually blended into the medullary cavity. The proximal end of the shaft was enlarged, the outer cortex was thinned, and showed a fine break. There was marked varus bending of the femur. Blood chemistry examinations and other laboratory work were negative.

At operation, the cystic area in the trochanteric region was opened and a small amount of serous fluid escaped. The content of the cavity consisted of blood clot, fibrous tissue with calcium deposit. The cavity was curetted and filled in with thin tibial bone grafts. A hip spica cast was applied. Bacteriological findings were negative. Pathology report: osteitis fibrosa.

Six months after the operation the bone grafts were resorbed to a great extent and did not lead to more marked osteogenesis. The lesion in the upper end of the femur had extended downward and occupied almost the entire upper third of the shaft. There was another area of more circumscribed osteoporosis at the junction of middle and lower thirds. Three months later, the roentgenograms were essentially the same, but there was another area of porosis with irregular calcification a little below the first de-

scribed lesion. The lateral cortex was considerably thinned out. Sixteen months following operation the roentgenograms showed some increased calcification at the site at which the bone grafts were put in. The irregular structure in the femoral diaphysis was now more evident, especially the cortical focus at the junction of middle and lower thirds was quite sharply outlined and defined by some osteosclerosis. All other bones of the body were negative. Six months later (2 years after operation), there was no doubt about the very extensive involvement of the femoral diaphysis and especially of the outer cortex, which was very thin by erosion from within (eccentric atrophy). The process extended from the upper metaphysis downward to the junction of middle and lower thirds. It led to marked osteoporosis and irregular bony structure but without definite cyst formation. Varus deformity of shaft and neck.

Patient had been well all the time, she walked with the typical gait of a coxa vara. At times, after walking a long way, she had some pain at the upper end of the femur. Inasmuch as the X-ray pictures showed a very slow but definite progress of the lesion and deformity, another attempt at curettage, bone grafting, and corrective osteotomy seemed to be indicated.

Second operation (2 years after the first). Through a longitudinal lateral incision, the upper half of the right femur was exposed from the trochanter down-

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Fig. 2. Case 2. A 10-year-old boy with a large, irregular, lytic lesion in the upper third of the femur. The lesion was removed by a wide resection, and the bone was reconstructed with a bone graft. The patient was followed up for 1 year, and the bone was found to be well healed.

ward The periosteum was stripped the cortical bone was found atrophic but smooth There was considerable thickening of the periosteum over the trochanter There was also a small defect in the bone filled by scar tissue at the site where a window was cut in the bone at time of first operation The hole upper end of the femur and the medullary cavity were filled with a firm white tissue of rather high consistency in which a few pieces of bony tissue were included Only in the region of the greater trochanter some grayish white and soft granulation tissue was encountered The tissue as expanding toward the cortical bone which showed roughness by erosion on its inner side At time of operation it seemed that the entire pathological tissue was removed from the upper half of the diaphysis Normal bony marrow was encountered at the distal end of the saucerization To judge from the roentgenograms however some focus in the lower half of the diaphysis remained It did not seem necessary to correct the deformity of the femur by an osteotomy at the same time The bone was quite porous and even more weakened by the radical resection procedure A bony cast was applied

Pathological examination of the removed tissue showed very dense fibrous tissue with relatively few vessels Bony trabeculae were imbedded in an irregular way Most of them were of fibrous type with good calcification of the central portion There was no good calcification of the peripheral portion Where the bony trabeculae appeared the bone marrow in the neighborhood was loose rich in cells and vessels and stood out very distinctly by its paler staining It was free surrounding dense fibrous marrow It was frequently found that smaller foci of younger and therefore looser bone marrow were almost completely sur-

rounded by a group of bony trabeculae In these places the outer side of the bony trabeculae was rather smooth and the dense fibrous bone marrow showed concentric condensation of its fibers parallel to the bony trabeculae The inner surface which faced the loose bone marrow was more irregular and sometimes showing osteoblastic bone apposition sometimes osteoclastic bone resorption The cortical bone had undergone marked resorption changes from the endosteal surface Fibrous bone marrow was invading the cortical bone along the Haversian canals There was very little periosteal reaction on the outside The picture was that of a more advanced stage of osteitis fibrosa with extensive encasing of the fibrous bone marrow In some places the scar formation reached such a degree that large areas were seen without any bony tissue and with beginning hyaline degeneration of collagenous fibers

Patient made an excellent recovery Three months later to correct the marked varus deformity of the neck and shaft a long oblique osteotomy was performed A defect in the cortex still remained The medullary cavity was found to be filled with the same dense material as at the time of first operation recurrence of osteitis fibrosa The bone was curetted out thoroughly The distal fragment of the femur was brought into abduction on the neck to correct the deformity A cortical bone graft was removed from the same tibia and placed in the cavity in the trochanteric region A double hip plaster cast was applied

Ray pictures showed very good correction of the deformity following oblique osteotomy The cast as removed 3 months after operation The osteotomy was solidly healed and weight bearing was allowed in a short hip spica cast and 8 months after operation without any support There was no pain but there was still a marked limp due to the abductor insufficiency (coxa vara) Ray pictures 10 months following osteotomy showed perfect healing of the osteotomy with very good callus formation The upper two thirds of the femur showed a great number of small cystic areas with a coarse spongy trabeculae between them and very good calcification Still from the ray pictures the process seemed to be active

Before entering the discussion of this unusual and interesting case of osteitis fibrosa we shall report another case which in many respects is similar to Case 21

CASE 22 A male 21 years of age when 12 years old had a sudden sharp pain in the middle of the shaft of the left femur with muscle spasm Such an attack of pain recurred frequently especially when walking to school (2 miles) Three weeks after the last episode he slipped and fractured the left femur He was put in traction and cast At the age of 16 the same type of aching recurred Ray pictures were taken and showed cavities in the bone and the doctor told him that the fracture had been patho-

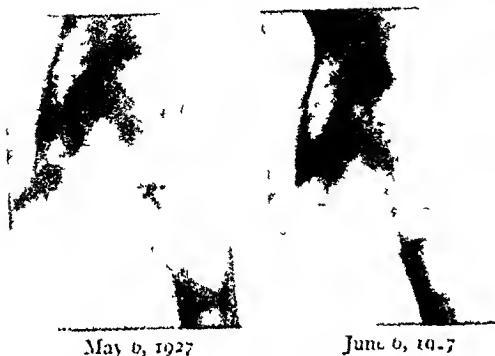


Fig. 13. Case 22. Min., 21 years old. Diffuse lesion of the diaphysis of the femur. Healed pathological fracture in the middle of the diaphysis. Treated by curettage and heavy cortical bone grafts.

logical. He used crutches for 7 weeks. Then, the left leg was as useful again as the right. Same symptoms recurred at age of 20 years. Under symptomatic treatment he improved and at time of admission the only difficulty consisted in in achieving pain in the left thigh when he walked longer distances.

On physical examination, a slight fusiform swelling of the left thigh at the junction of the middle third was found, corresponding to the site of the old fracture. Blood chemistry was normal (calcium 11.6, phosphorus 3.8).

X-ray pictures showed a cystic area in the upper end of the shaft of the left femur, extending into the neck of the femur and farther down in the diaphysis. The lower end of the lesion, however, was not included in the picture. The cavity was not sharply outlined.

At operation, the cortex of the upper end of the femur was unusually thin. Under the cortex, very dense, white fibrous tissue was encountered. There was no real cyst formation. The fibrous tissue extended proximally into the neck of the femur, distally it extended beyond the level at which exposure was made. There, however, the cortex did not seem to be involved. Only the medullary cavity was filled with fibrous tissue. This tissue was cleaned out thoroughly with a curette, but no attempt was made to follow the process up into the neck, and distally the operative procedure stopped at the point at which the fibrous tissue narrowed down into the medullary cavity. A heavy, tibial cortical bone graft was cut in several pieces and jammed firmly into the cavity of the femur. Immobilization in plaster splint. Patient made a good recovery.

X-ray pictures 1 month after operation showed the window in the lateral cortex of the subtrochanteric region. The cavity had been filled with a number of heavy cortical bone grafts. The femoral diaphysis showed widening of the shaft with several cystic areas, quite of the same appearance as in the upper third. Most marked widening, spindle shaped



in character, was present in the middle of the diaphysis where the bone was blown up and the cortex thinned down to a paper like shell on one side, whereas the other showed definite periosteal bone apposition. Through this area ran an irregular transverse line suggestive of the old fracture which had healed with good bony callus formation. The bony structure was very irregular, mainly consisting of osteoporosis with cloudiness and thinning of the cortex from within (eccentric bony atrophy). The pathological changes extended almost continuously from the upper third down to the junction of the middle and lower thirds. There was no soft tissue involvement.

Patient returned 2 years after the operation, stating that after leaving the hospital he gradually began to use the left lower extremity. Five months ago, however, the original symptoms reappeared in the same intensity, so that he had to use crutches again. Blood chemistry at eleven different occasions showed normal values. On the basis of the X-ray pictures, however, the remote possibility of being a case of hyperparathyroidism was considered. X-ray pictures of all the bones of the body were taken, but were negative with the exception of the left femur. An exploratory operation of the parathyroid glands was performed. All four glands were exposed, but there was no evidence of enlargement in any. None of the glands was removed.

Patient was seen last  $3\frac{1}{2}$  years after operation. He had been walking off and on with crutches. He







Fig 15 Case 24 Female, 23 years old Diffuse cystic involvement of the diaphysis of humerus, radius, and bones of the thumb

January 19, 1935



Fig 16 Same case, showing the involvement of the first metacarpal bone and first phalanx

bony trabeculae of primitive fibrous bone tissue. The periosteal bone formation in these cases is apparently normal, as long as the cortical bone is still present, the periosteal surface is smooth and nothing suggests a more marked participation of the periosteum in the pathological process, the latter seems to be confined entirely to the bone marrow. However, if there is a pathological fracture or if following operation a larger defect in the cortex has to be filled in, a more adequate stimulus is exercised upon the periosteum, which then reveals its normal power to osteogenesis. This factor could be very well observed in both the cases.

From the study of these 2 cases and from observation of Cases 13, 16, 18, and 20, it appears that there are certain cases of osteitis fibrosa (of the solid, not cyst-forming type) which show definite signs of progression and recurrence despite surgical interference. They cannot be called osteitis fibrosa localisata because there is no real localization strictly speaking, it is better to speak simply of a monosseous type of osteitis fibrosa. Such cases make the usually good prognosis in cases of osteitis fibrosa somewhat doubtful.

fibrocystic process could not be stopped by an extensive curettage and bone graft operation. It is true that, despite the most thorough removal of the pathological tissue, in none of the cases of osteitis fibrosa can one be sure that all tissue has been removed. However, this does not seem to be necessary, as many cases responded well to the routine surgical treatment. Osteitis fibrosa is not a neoplastic, but a dystrophic, disease of the bony tissue, and the cleaning out of the "diseased" tissue aims more at stimulation and making room for new and normal bone growth than at radicality in the sense of surgical attack of a tumor. But this is what, for some unknown reason, this type of case of osteitis fibrosa lacks: the endosteal bone production in a very extensive portion of the diaphysis does not lead to normal bone but to dense fibrous tissue with a few



F 7 Case 25

If we neglect Cases 19 and 20 in which more than one bone was involved we may state that all the other cases even if as extensive as Case 21 and 22 were monostrophic lesions with essentially normal blood chemistry. There was nothing to suggest a metabolic disorder on the basis of which the bony lesion could have developed. We must assume local irritative factor in the bone marrow which lead to the characteristic picture of osteitis fibrosa. The presence of more than one circumscribed lesion in different parts of the skeleton however makes it not unlikely that at least for a number of cases a certain predisposition of the skeleton to fibrocystic osteodystrophy has to be assumed probably upon an embryological basis.

Thus is even more so if we find cases in which the distribution of osteitis fibrosa follows certain anatomical structures which make it certain that the lesion must be caused by intrinsic (endogenous) and not extrinsic factors as for instance trauma. We had the



Fig 8 Case 5 Femur 2 year old Diff. of element of the left femur 1 m 1 d of 1 ft 1 bsa Strictly unilateral

opportunity to study 3 cases (Cases 23, 24 and 25) with strictly unilateral distribution of the dystrophic lesion. One case had been previously reported by one of the authors (E. Freund) and the term osteodystrophia fibrosa unilateralis was suggested for this type of lesion. We report here briefly the case again.

CASE 23. A 13 year old girl at age of 5 began to limp. When 6 years old she fractured the left femur. There was solid bony union after 1 year of traction and fixation in a plaster cast. Her mother stated that the left leg had been bowing progressively during the last years. On physical examination one found a well developed white girl with marked asymmetry of the face and extremities. Especially the left lower extremity showed a marked anterior and varus bowing. X-ray pictures of the left ilio-pubic pelvis and bones of the right extremities did not reveal pathological changes. The left humerus revealed definite hyperostotic porotic changes involving almost the entire diaphysis. Only in the distal end and in the upper epiphysis could normal bone structure be seen. There was an almost uniform and equal thickening of the diaphysis. The cortical bone was markedly thinned out and formed only a very thin bony layer which however in no place was completely interrupted. The surface of the diaphysis was smooth and there were no signs of actual periosteal bone apposition. The shadow of the bone was cloudy and porotic only in a few places could a definite structure be seen. These areas probably represented areas of spongy bone where the pathological changes had not yet appeared. The picture was that of diffuse osteoporosis without cyst formation. In addition to the marked increase in thickness the diaphysis showed also a distinct increase in length (three fourths inch) despite the bowing in the middle third. There were no signs of recent or healed fractures.

Lesions similar to those of the humerus were seen in the diaphysis of the left radius and in the bones of

the thumb. Essentially the same structural changes were also present in the left femur, only the epiphysis of head and greater trochanter, the distal metaphysis and condyles were spared. Of both bones of the left leg, only the tibia was involved. Almost the entire diaphysis showed the same hyperostotic process which led to an increase of thickness and length, resulting in bowing of the tibia. There was marked valgus deformity at the junction of middle and upper thirds. The changes in the left foot corresponded to those in the left hand, the bones of the big toe only were involved. There was also some irregularity in the bony structure of the first cuneiform bone and possibly of the scaphoid. But it was difficult to ascertain whether these changes were due only to atrophy resulting from disuse.

For further information, a biopsy was performed at the junction of middle and lower thirds of the left tibia. The histological picture was that of osteitis fibrosa. Blood chemistry showed normal values (calcium 11.1 milligrams and phosphorus 3.9 milligrams), phosphatase were increased to 32.5.

Because of the roentgenological and histological findings von Recklinghausen's osteitis fibrosa was considered as a diagnosis and the parathyroid glands were explored. No parathyroid adenoma was found. The two lower parathyroid glands were removed. The histological findings were normal.

A corrective oblique osteotomy was performed with the electric saw, in the same manner as in Case 20. There was not good bony callus formation before 6 months. The patient showed good correction of the deformity and was walking in a hip spica brace. Frequent roentgenological control examinations did not show appreciable changes since first admission.

CASE 24. A woman, 23 years of age, when 8 years old fell 4 feet and broke the right humerus in two places. This healed with deformity in normal time. At the age of 10 she was thrown from a horse and fractured her right wrist and the lower end of the right humerus. This healed in 4 to 5 weeks. She hurt the upper end of the forearm 3 months before admission and had had pain for 1 week. At that time she was seen in the hospital and showed, on physical examination, a bowing of the right humerus with two bulbous enlargements of middle and lower thirds of the shaft. There was no other deformity in any other portion of the skeleton, no asymmetry of the face. Roentgenograms were taken of the whole skeleton but have been discarded since. They were reported as negative except for the right humerus, right radius, and right thumb. A diagnosis of osteitis fibrosa cystica was made and at that time no special kind of treatment seemed to be indicated. At the age of 23 she returned with a fresh fracture of the right humerus at the junction of middle and lower thirds. She stated that in the meanwhile she had attended a course in nursing in Chicago. During this course she fell and fractured the shaft of the right radius. The arm was immobilized in a plaster cast, and the fracture healed within 4 weeks. Possi-

bility of hyperparathyroidism was considered and the patient received four X-ray treatments to the neck region. She was in the best of health and without any symptoms from her right arm until she fractured the right humerus a day before admission. The fracture was set, and she was put in a shoulder spica. There was good callus formation in 6 weeks. Blood chemistry showed normal values (serum calcium 10.7 milligrams, phosphorus 3.4 milligrams, and phosphatase 5.4 milligrams).

Roentgenograms were taken of all bones of the body but pathological changes were found only in the right upper extremity, and here only the bones of the outer side were involved: humerus, radius, and bones of the thumb.

The humerus was considerably enlarged. The enlargement was mainly due to thickening, but there was also some real lengthening. Measurements of the roentgenograms showed the right humerus to be 15 inches long, the left being only 14 inches long. If one considered the existing lateral bowing of the right humerus, then the difference in length became even more marked. The upper and lower epiphyses of the right humerus showed perfectly normal shadow, the entire diaphysis, however, was altogether pathological. The cortical bone was thinned out very considerably, especially in the outer side, but in no place entirely interrupted. In some places it was difficult to speak of a real cortex. The bony shadow ended sharply toward the surrounding soft tissues. The periosteal surface was smooth, the diaphysis was remarkably thickened. The middle of the diaphysis was 2 inches in diameter versus  $\frac{3}{4}$  inch on the normal, left, side. The bony structure can be called a diffuse osteoporosis with an even more marked degree in the lower half. There, one may even speak of a cystic area from the roentgenological point of view. Where the more solid bone tissue bordered at the cystic area, there one could still see two transverse lines of increased density, suggesting the places where previously pathological fractures or im-

fractions had occurred. Bony trabeculae could be made out on the inner concave side where they even showed a certain static arrangement, whereas most of the porotic areas appeared in a more diffuse cloudy shadow. The normal outline of the humerus spoke against active periosteal bone production, but one found at the upper third of the outer cortex definite signs of periosteal bone formation in form of a layer of porotic bone tissue at the surface of the old cortex.

The only bone of the forearm which was involved was the radius. The changes were very similar to those of the humerus, but not as extensive. The upper third appeared blown up to about twice its normal size. The cortex was markedly thinned out or bad even disappeared entirely. Nevertheless, there was a sharp outline of the bony shadow everywhere. The bony structure of the upper third was again of the same hazy, cloudy structure without definite signs of bony trabeculation, but the whole area did not exactly give the impression of being cystic. The

cloudy shadow extended up in the head of the radius but in the anteroposterior view one found a narrowed zone of normal bone structure in the subchondral region. The proximal blown up area was separated from another focus in the distal third by a kind of hour glass constriction of 5 inch length where the bony structure seemed to be more normal. The distal focus was almost 4 inches long 3/4 of an inch wide and rather sharply outlined almost of cyst like appearance. The cortex was thinned out shell like but in no place interrupted. The distal epiphyses showed perfectly normal bony structure. There was no increase in the length of the radius.

All the carpal bone had normal bone shadow. The first metacarpal bone showed thickening with the same irregular cloudy bony shadow eccentric atrophy of the cortex and instead of the normal bi concave shape a diffuse bulging. The proximal epiphysis was of normal bony structure the distal end however showed the same pathological structure as the diaphysis which agreed very well with the absence of a distal epiphysis in the first metacarpal bone. Similar changes were also present in the first phalanx. Here too the proximal end was spared but the bony surface was increased in thickness. No definite changes were present in the distal phalanx.

This description was taken from plates which were sent us by courtesy from the X-ray Department of St. Luke's Hospital of Chicago. Incisions taken at re admission to the hospital showed essentially the same changes with a fresh transverse fracture through the middle of the diaphysis of the humerus.

From the roentgenological appearance there can be no doubt that Case 24 represents the same pathology as Case 23. The roentgenograms of the involved upper extremities are almost identical. The difference between both cases lies only in the fact that Case 24 showed involvement of the upper extremity alone whereas Case 23 revealed the same pathological changes in the left upper and lower extremities. Case 24 represented only a monomelic type of this unilateral lesion with out any changes in the face. Monomelic changes without asymmetry of the face were also present in Case 25 which with its involvement of only femur and tibia forms a very welcome pendant to Case 24 the one representing the monomelic form of the upper the other of the lower extremity.

CASE 25. Patient a 27 year old woman was admitted to the hospital for an appendectomy. She complained also of pain in the left hip of 18 years duration. The pain was intermittent and when more severe she was forced to limp. There was no history

of trauma or fracture. On physical examination a slight atrophy of the left lower extremity was found but there was no difference in length. The leg was perfectly straight but the femur showed a diffuse bony enlargement and was tender on pressure. There was no soft tissue swelling. Blood chemistry normal (calcium 9.2 milligrams phosphorus 3.3 milligrams). Roentgenograms disclosed pathological changes only in the left femur and tibia all other bones of the skeleton were perfectly normal.

Left femur showed a very extensive involvement of the diaphysis leading to a very irregular picture of hyperostotic porotic changes. Only a small portion of the lower third of the diaphysis was spared all the epiphyses appeared in perfectly normal bony structure. This could be seen especially well at the junction of the neck of the femur with the head and greater trochanter. There was a sharply cut border line between healthy and pathological bone tissue corresponding exactly to the site of the previous epiphyseal plates. The porotic changes led to complete removal of normal bony tissue with formation of a very coarse porotic bony structure with more circumscribed areas of increased osteoporosis of cyst like appearance. These changes were associated with expansion of the bone so that in the upper half the left femur was twice the size of the right. The cortical bone showed irregular thinning out from within frequently to a paper thin shell of bone. Still the outer surface of the femur remained smooth there were no signs of more marked pen-teal reaction although the thickening of the shaft must have occurred by very slow pen-teal bone proliferation. The inner structure could best be described as pseudocystic. There were no definite signs of fracture but some coarser re-need transverse lines of bony trabeculation especially at the junction of upper and middle thirds were suggestive of callus formation. An irregular area of grape like calcification was present at the junction of middle and lower thirds where a calcified chondromatous mass could be considered. Otherwise however the picture was entirely different from that of skeletal chondroma.

From the anatomical distribution of the bone involvement in these 3 cases it is quite evident that we deal with a multisystemic systemic affection of the skeleton. Pathological changes occur along certain rays. In the upper extremities only the humerus radius and bones of the thumb are affected. And similarly in the lower extremity only the femur tibia and bones of the big toe are affected. All other bones are perfectly normal. Unilaterally therefore means not that all the bones of the affected extremity are involved but also that even the involved bones do not show pathological structure in all their

portions Very characteristically, the epiphyses are constantly spared and the diaphyses show variable degrees of extension of the pathological changes This is also true after the bone growth has stopped and the epiphyseal disc has disappeared, as shown in Cases 24 and 25, both about 22 years old One has, therefore, to conclude that we deal here with a purely diaphyseal pathology, evidently with disturbance of the endosteal bone formation and without participation of the periosteum There is nothing to suggest a disturbance of the enchondral ossification The bone production at the epiphyseal discs seems to occur quite normally It even appears that there is increase in length growth, probably due to the hyperemia of the bone marrow of tibia and fibula This could also be observed in Case 20, which showed multiple involvement Pathological changes seem to become manifest with the so called "internal molding resorption" which removes the primary spongy bone, replacing it with mature lamellar bone of static arrangement, in normal cases In the affected bones of the 3 unilateral cases, however, the internal molding resorption, for some unknown reason, instead of leading to the formation of lamellar bone produces fibrous bone marrow with fibrous porotic spongy bone The process is evidently of very long duration and only of slow progress In all the cases it started apparently in early childhood and gradually involved the diaphyses From the roentgenograms of the tibia of Case 25, it appears that the pathological changes in the affected bones do not develop from one center with gradual involvement of the surrounding healthy bone, but they start apparently simultaneously in different foci which first are separated but may merge later and give the picture of a diffuse involvement

In the article referred to an attempt was made to define the term of osteodystrophia fibrosa unilateralis as well as possible and to rule out certain other bone diseases with which it has a number of symptoms in common Especially Ollier's dyschondroplasia had to be ruled out because of the unilaterality of the disease and the asymmetry of the face Ollier's disease, however, represents an intrinsic dis-

turbance of enchondral ossification with formation of chondroma-like tumor masses at the site of the metaphyses It is observed within the first year of life and usually leads to marked deformity and shortening of the affected extremities In our cases clinical symptoms did not develop until after the fourth year of life in Case 25, the fifth year in Case 23, and the eighth year in Case 24 Real shortening as in Ollier's disease could not be observed On the contrary, the involved bones in 2 cases tended to increase in length, and there was a real lengthening if secondary more marked bowing of the softened bones did not occur Besides this, the roentgenological appearance of the affected bones was altogether different from that in Ollier's disease They lacked entirely the coarse structure in the metaphyses with the characteristic club-like enlargement They showed a more or less extensive involvement of the diaphyses only, with changes which best can be described as hyperostotic-porotic without participation of the periosteum Against Ollier's disease spoke also the absence of cartilaginous tissue in the piece of tibia removed from Case 23

On the basis of the findings in Cases 24 and 25, another systemic skeletal lesion has to be considered from the differential diagnostic viewpoint, and this is the melorheostose Léri This was not done in our first article because of the unilaterality of Case 23, all the cases of melorheostosis showing only involvement of one extremity in which a number of bones (never all) become changed in a very peculiar way Léri compared the appearance of the involved bones very adequately with the flow of the melted wax along the surface of a candle There is, similarly as in our cases, a certain ray distribution of the pathological process, the flow, for instance, starting with the scapula, running down the humerus, radius, thumb, or third finger By the way of distribution and by its monomelic appearance, melorheostosis has certainly a strong resemblance to our Case 24 This differs, however, quite considerably because of a number of other symptoms Melorheostosis, as a rule affects male adults The average age of a great number of cases reported in the literature is  $15\frac{1}{2}$  years The roentgenological

appearance is very typical consisting in an osteosclerotic process which affects epiphysis as well as diaphysis endosteal bone as well as periosteal bone leading especially by the latter to the irregular thickening of the bones with drop-like prominences on the periosteal surfaces. Our 2 cases were both very young girls when the process started and the X ray picture is characterized by the hyperostotic porotic change which means that the affected bones show cloudy shadows (porosis) with diffuse or spindle shaped widening (hyperostosis). So despite the monomelic affection and peculiar systemic anatomical distribution melorheostosis can safely be ruled out.

#### RELATION OF OSTEODYSTROPHIA FIBROSA UNILATERALIS TO COMMON OSTEITIS FIBROSA

Remains the discussion of the relation of osteodystrophia (osteitis) fibrosa unilateralis to the more common type of osteitis fibrosa cases. They have in common the histological findings. We have however in our previous article stressed the point that the histological picture of osteitis fibrosa cannot be taken as a specific reaction of the bone marrow. We know that the same changes may occur under quite different stimuli and so the histological diagnosis of osteitis fibrosa may frequently be misleading and obscuring. In both of our cases however certain roentgenological signs especially the apparent cyst formation led to the first clinical diagnosis of cystic osteitis fibrosa. In Case 23 at time of first admission only X ray pictures of the pelvis were taken (all the clinical symptoms pointed to the left hip) and so the diagnosis is quite justifiable. In Case 24 pictures were taken of all the bones of the body and a multiple cystic lesion was recognized. The extensive involvement of the bones of course speaks primarily and decidedly against a localized lesion of osteitis fibrosa. The multiple bones affected suggested generalized osteitis fibrosa in the sense of von Recklinghausen's disease or hyperparathyroidism although the systemic distribution with unilateral or monomelic manifestation speaks *a priori* against a central cause. Blood chemistry in all 3 cases was essentially negative especially as far as the calcium and phosphorus values were concerned. Nevertheless

in Case 23 an exploratory operation of the parathyroid glands was performed two glands being removed with perfectly normal microscopic and macroscopic appearance. In Case 24 the neck region was irradiated with X ray without any changes in the skeleton.

It is quite certain that both cases have essentially nothing to do with generalized osteitis fibrosa. Against it speaks the age (Recklinghausen's disease is not observed in childhood) the roentgenological appearance (Recklinghausen's disease leads to marked general osteoporosis of the skeleton with cyst formation and brown tumors hyperostotic changes take place only at the site of pathological fracture our cases showed very characteristic hyperostotic porotic changes with systemic unilateral or monomelic distribution. There were no definite signs of real cyst formation) and finally the normal clinical findings with absence of general symptoms.

Thus it seems that osteodystrophia fibrosa unilateralis deserves an independent position among the osteitis fibrosa cases. And as a matter of fact this was also the conclusion in the paper referred to. However since the observation of Cases 24 and 25 which can be considered as less extensive unilateral cases it is theoretically possible to assume that there are different degrees in extension of fibrous osteodystrophy. One could think that in the same way as Cases 4 and 5 monomelic distribution represents a reduction of a strictly unilateral manifestation the extensive monosseous cases represent less extensive degrees of monomelic forms and finally that the localized lesion could be considered as the mildest form in the development of fibrous osteodystrophy. Case 25 especially with the changes in the tibia just in the beginning and the bones of the foot perfectly free is a very welcome link in the chain of different manifestations of fibrous osteodystrophy. It stays between the monomelic case (Case 24) and the monosseous diffuse form (Cases 21 and 22). Such an assumption is of course very hard to prove since we know so little about the etiology of fibrous osteodystrophy. But it does not seem entirely artificial if one considers the very marked regularity in the distribution of our 2 cases in which as far as the

upper extremities are concerned, the lesions resemble each other like one egg another. Furthermore, the typical localizations of the localized monosseous type would also fit very well in this conception of a primary endosteum lesion. It really must be quite surprising to find the upper metaphysis of the humerus, femur, and tibia so often involved without thinking of a certain intrinsic predisposition of these portions to fibrous osteodystrophy. It is always a metaphyseal or diaphyseal lesion without primary participation of the periosteum. Even after disappearance of the epiphyseal plates, the borderline between epiphysis and diaphysis remains strictly observed. It is a disturbance of endosteal bone formation in the diaphysis which starts apparently most frequently in the juxta-epiphyseal portions where the primary spongy bone in normal cases is transformed to mature lamellar bone tissue. Of what kind this disturbance is, if the simple traumatic factor is unable to solve the problem, it is impossible to say with our present knowledge of bone formation and bone growth. It has to be admitted that trauma may facilitate the development of such a lesion, but it cannot be the real etiological factor. To our knowledge, all the experiments undertaken to cause localized osteitis fibrosa by trauma and intermedullary trauma have failed. In most of the clinical cases the onset is insidious and, when fractures occur, they are, as a rule, pathological, developing in the diseased and weakened skeletal portions. All the cases have in common the relatively benign clinical course which in the localized cases may lead even to spontaneous healing. The more extensive cases are, of course, not as favorable as far as prognosis is concerned, they even resist quite often radical surgical procedures, showing marked tendency to recurrence. The unilateral cases, however, are at present entirely inaccessible

for treatment, except for a symptomatic one in cases of complications.

Summarizing, we can say for the group of osteitis fibrosa. There are localized cases of a solid or cystic type, usually situated in the upper portion of the diaphysis of the humerus, femur, and tibia, less frequently, diaphyseal localization is observed, never localization in epiphyses. Besides the localized form, more extensive cases can occasionally be seen with involvement of the greater part of the diaphyses. Multiple localized lesions are rare but may occur without any apparent rule in the distribution of the lesion. There is a strictly unilateral (monomelic) form of fibrous osteodystrophy with involvement of the entire or of great portions of the diaphyses of bones arranged in longitudinal ray-like anatomical distribution. On the basis of such observations, it is believed that the localized form represents an abortive type of the extensive monosseous form. The latter is an abortive form of the monomelic type which, in turn, is considered as an abortive form of the unilateral osteodystrophy. Inasmuch as the latter cannot be taken as traumatic in origin, the purely traumatic etiology of all the other forms is rather doubtful. All the cases mentioned have apparently no nosological relationship to the generalized form of osteitis fibrosa. Von Recklinghausen's disease has to be considered as a generalized bone disease in which every part of the skeleton is affected. The degree of affection may vary, according to mechanic irritative factors. The distribution of cysts and brown tumors in the generalized form is irregular and does not follow certain rules. Disturbance of calcium metabolism and tumor formation in parathyroid glands is demonstrable almost in every case of von Recklinghausen's disease, never in the different "localized" forms of fibrous osteodystrophy.

# THE RELATION OF CHRONIC MASTITIS TO CERTAIN HORMONES OF THE OVARY AND PITUITARY AND TO COINCIDENT GYNECOLOGICAL LESIONS

## PART II—CLINICAL AND HORMONE STUDIES<sup>1</sup>

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**T**HE first part of this study which appeared in a previous number of this journal was concerned with a consideration of possible causes and the histology of the diffuse breast diseases commonly classed under the general term of chronic mastitis. Particular attention was devoted to the current belief in an underlying ovarian dysfunction and to an alternative theory giving nervous and vascular factors a more prominent role. The present paper is a continuation of this work and consists in a collection of clinical and laboratory evidence having a bearing on these two conceptions.

The clinical data for the study of chronic mastitis are based upon 261 cases of diffuse breast disease observed during the 3 year period of 1931-1933 inclusive. Of these 239 were primarily patients of the breast clinic at the Memorial Hospital whereas 22 were from the gynecological department of the Roosevelt Hospital.

### CLASSIFICATION

The original 261 cases have been divided first into three groups based upon the clinical character of the disease in the breast. The histological basis of these clinical forms has already been discussed. (1) In the first group were placed the 183 cases with tender areas of induration or nodularity. Among these patients were many who complained of a temporary premenstrual swelling but none with permanent enlargement or discharge from the nipple. (2) The second group consisted of 31 patients all of whom reported a permanent enlargement of the breasts usually with cyclical pain and swelling but without discharge from the nipple. (3) The third group of 47 cases was made up of the patients with discharge from the nipple which neces-

sarily included many with pain and 6 with hypertrophy.

A secondary classification based on a gynecological history and examination was made to bring out the importance of the two major theoretical etiological factors ovarian dysfunction and a nervous and vascular disturbance perhaps caused by or associated with pelvic lesions. Since the endocrine factor is more in harmony with present views the groups given below are arranged in order of the apparent prominence of glandular dysfunction. The incidence of lesions having a possible effect on the pelvic nerves is found in the data on inflammation, parametritis, retroversion and cervical infections.

The classification which has been employed is as follows:

1 Breast disease in association with cystic ovaries and menstrual abnormalities (anatomical and functional evidence of ovarian disorder)

2 Breast disease in association with cystic ovaries but normal menstruation (anatomical evidence only of ovarian disorder)

3 Breast disease without evidence of anatomical disease of the ovaries but with menstrual abnormalities (functional evidence only of ovarian disorder)

a Prolonged menstrual cycle 35 days or longer

b Scant menstrual flow 3 days or less

c Excessive or prolonged flow 8 days or more

d Short menstrual cycle 21 days or shorter

4 Breast disease following hysterectomy (functional disturbance of retained ovaries)

5 Breast disease without evidence of cystic ovaries or menstrual abnormalities but with signs of inflammation or pelvic congestion (no clinical evidence of ovarian disorder)

a Acute and chronic salpingo-oophoritis



TABLE I—CLINICAL CLASSIFICATION OF 183 CASES WITH BREAST PAIN WITH NODULARITY

		Total	Age	Marital Status				Menstrual Cycle				Duration of Flow	Uterus				Parametria	Adnexa				Cervix		Thyroid													
				Single	Married	No pregnancies	Miscarriages only	One or more children	Normal	Long cycle 35 days or more	Short cycle 23 days or less		Irregular 21-35 days	Continuous	Amenorrhea	Normal		Short menses <3 days	Long menses >7 days	Normal	Retroversion 1st degree	Retroversion 2nd degree	Retroversion 3rd degree		Partial prolapse	Fibroids	Normal	Tenderness dyspareunia	Normal	Acute salpingo oophoritis	Chronic salpingo oophoritis	Previous salpingo oophoritis	Cystic ovaries	Prev. removal cystic ovary	Normal	Laceration	Lesion
1	Cystic ovaries and abnormal menses	11	29	2	2	0	7	5	1	4	1			1	7	3	3	2	2	4		2	9	2		6		9	2		1	4	1	1			
2	Cystic ovaries and normal menses	18	31	2	4	2	10	18						18			6	2	1	6	3	3	13	5		3	3	16	2	2	0	8	4				
3	Abnormal menses but no demonstrable cystic ovaries																																				
a	Long cycles	23	32	5	3	4	11	18		5				18	4	1	11	3	2	3		2	18	3	20	1					3	3	2	4	1	2	
b	Short flow	20	33	4	2	0	14	18		2				20			2	4	5	3	3		12	5	17						7	4	3	2	1	3	
c	Excessive flow	5	39	1	3	0	1	3				2					5	5				3	5	0	5							1					
d	Short cycles	15	33	1	3	0	11		15					15			4	3	5	2		7	7	13	1					4	2	4	1		1		
4	Posthysterectomy	2	32				2						2									2	2							1							
5	Normal menses with pelvic inflammation or congestion																																				
a	Pelvic inflammation	9	32	0	4	2	3	9						9			4	4	1	0	0	2	6	3		1	6	2		3		2	1				
b	Pelvic congestion parametritis	24	32	1	3	2	18	24						24			10	6	6	2	2	4	24	24						3	5	9	4	1			
c	Retroversion	17	34	1	3	0	13	17						17			0	0	7	9	1		17	17						2	7	5	1	2			
d	Cervical infections	8	30		2		6	8						8				5	3				8	8							4	1	3				
e	Sexual factor only	3	33	1	1		1	3						3			1	1					2	2						2					1	1	
6	Primary dysmenorrhea	12	25	11	1			12						12			3	1				1	4	4						3				2	8		
7	Thyroid hypertrophy	4	29	1	1		2	4						4			1	2					3	3						3				4	1		
8	Unclassified	12	30	6			6	12						12			5	4				1	9	9						6						3	
Total		183	30 7	36	33	9	102	133	19	21	6	2	2	141	31	9	60	35	29	29	9	13	112	49	124	4	17	2	26	41	26	37	21	1+	19		

b Chronic parametritis and pelvic congestion

c Retroversion and partial prolapse

d Cervical infection and hypersecretion

e Presence of an apparent sexual relationship

6 Breast disease with primary dysmenorrhea

7 Breast disease with thyroid hypertrophy

8 Unclassifiable cases

The first four groups contain all the cases in which there were clinical signs or symptoms

suggestive of an ovarian dysfunction Group 5 includes cases without evidence of an ovarian dysfunction but with lesions in the pelvis, making an irritation of the pelvic sympathetic nerves a possibility A number of cases with such pelvic disease showed also evidence of ovarian abnormality and have been arbitrarily classed in the dysfunction groups The total incidence of pelvic lesions can therefore be obtained only by reference to the detailed tabulation in the charts (Tables I, II, III) Cases with no classifying feature except pri-

## SURGERY GYNECOLOGY AND OBSTETRICS

TABLE II—CLINICAL CLASSIFICATION OF 31 CASES WITH HYPERTROPHY OF THE BREAST

T	Age	Marital Status	Menstrual Cycle	Duration of Flow	Uterus	P. met. na	Adnexa	Cervix	Thy. id
Cyst. and mal. on nose	3	3			3				
Cyst. ovaries and mal. on nose	3	3							
3 Abno. mal. m. sea b. l. d. m. o. a. Long y. les									
b Sh. flow		3							
Excessu. flow							6	6	
d. Short cy. les			3		6				
Poosthystec. my	6	31							
s. N. m. l. m. s. w. l. d. m. a. P. l. d. m. a. t. u.									
b P. l. y. e. p. a. m.									
Re. r. o. r. i.		30					3	3	
d. Cer. al. fee. na					3				
Sexual. ly	3	3			3				
m. r. y. dy. m. e. n. o. h.	3	3							
Thyro. d. h. p. e. t. r. y.		3							
Unclassified				9	6				
T. tal									

mary dysmenorrhea or thyroid hypertrophy have been separately grouped since these conditions may have either an endocrine or nervous significance

## METHODS OF HORMONE STUDY

As patients were admitted to the clinic typical examples were selected for hormone studies based on four types of analysis

- 1 The urinary excretion of estrin. Estrin was obtained from the urine by the chloroform extraction method of Frank (15) and assayed

by injection of the extract in oil into spayed adult white mice. In all except the earlier determinations a positive reading was accepted only when full estrus occurred in three of four animals injected with the same quantity of hormone according to the plan of Sieble (53). On account of the variation in excretion at different times in the monthly cycle the total estrin excreted during a menstrual cycle was determined by the separate assay of consecutive 72 hour total urine specimens.

TABLE III—CLINICAL CLASSIFICATION OF 47 CASES WITH ABNORMAL SECRETION FROM THE NIPPLE

		Age	Total	Average age in years	Marital status			Menstrual cycle			Duration of flow			Uterus			Para met- ria		Adnexa			Cervix		Thy- roid																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
					Single	Married	No pregnancies	Miscellaneous only	One or more children	Normal	Long cycle 35 days or more	Short cycle 23 days or less	Irregular 21-35 days	Continuous	Amenorrhea	Normal if duration	Short menses <3 days	Long menses >7 days	Normal if	Retroversion 1st degree	Retroversion 2nd degree	Retroversion 3rd degree	Partial prolapse	Fibroids	Normal	Underness dyspareunia	Normal	Acute salpingo oophoritis	Chronic salpingo oophoritis	Previous salpingo oophoritis	Cystic ovaries	Prev removal of cystic ovary	Normal	Laceration	Erosion	Indecrivitis	Hypertrophy	No pelvic examination																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
1	Cystic ovaries and abnormal menses	33																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

The normal excretion of estrin during a single cycle was found by Frank (15) to vary from 800 to 1,500 mouse units, by Siebke (51) from 200 to 2,000. A peak of excretion near the time of ovulation was noted by both of these workers and a second peak shortly before menstruation by Frank (15). Control tests made upon 4 normal women in the course of this study gave a range of 760 to 2,625 and an average of 1,505 mouse units. The study of the patient with the highest output was

completely repeated after a 6 months' interval, the second determination showing 3,155 units. The highest rates of excretion were found near the middle of the month, but occasional unexplained peaks occurred at other times.

On account of the many types of menstrual disturbance reported in cases of chronic mastitis, it is important to reconsider the variations in hormone excretion that have already been reported in relation to these menstrual abnormalities. Menstrual cycles of increased

length may according to Siebke (54) be of two kinds: those with a period of complete rest preceding the beginning of the usual hormone cycle and those with a continuous hormone excretion possibly with several peaks during the entire interval. Amenorrhea similarly may be of several types (Frank and Goldberger 16) varying from the practical absence of hormone in blood and urine to the excessively high levels reported in the so-called polyhormonal amenorrhea of Zondek (60). The hormone basis for the short cycle has been little studied. The variability of amount and duration of the menstrual flow within relatively normal limits is not according to Siebke's (52) observations dependent upon quantitative variations in the ovarian function.

**Blood estrin.** The test of Frank and Goldberger (17) for the female sex hormone was employed for study of the presence of the hormone in the blood. The originators of the test maintain that a positive reaction as a rule may be obtained in normal women during the premenstrual week. This has been both corroborated (Hirsch, Siebke 51; Mazer and Andrusier) and contradicted (Janney, Ford and Mueller). Experience with a short control series has shown that in our hands negative tests are not infrequently obtained during the premenstrual week, a point to be remembered in interpreting the results given below. In a few recent cases the test of Fluhmann (11) based on the production of mucification of the vaginal mucosa of the spayed mouse has also been used.

An increase of follicular hormone in the blood has been observed in certain types of bleeding at puberty and the menopause (Frank and Goldberger 16 and Siebke 52). High values have been found also in certain cases characterized by premenstrual nervous tension in which various vascular and nervous symptoms are prominent and dysmenorrhea with breast pain and swelling may be present (Frank 14). Low values have been found in some women with functional sterility but normal menstrual cycles (Frank 14; Mazer and Andrusier).

**3. The urinary excretion of prolan.** Attempts were made to demonstrate the pres-

ence of prolan in the urine by the use of the alcohol precipitation method of Zondek (62) and the benzoic and tungstic acid method of Katzman and Doisy (27, 29). Extracts by the two latter methods were prepared by and under the direction of Dr. Helen Downes of the department of chemistry of the hospital. These tests also were carried out upon a series of urines obtained at 3 day intervals throughout the menstrual cycle.

Previous estimations of the daily prolan output of normal women have varied widely. Zondek (64) reported 8 units per day in the postmenstruum, 2.5 in the interval, 2.9 in the premenstruum and 2.5 during menstruation. Katzman and Doisy (28, 29) found a maximum excretion of 12 to 16 mouse units at about the time of ovulation and sometimes a rise during menstruation with the amounts between these times falling to three mouse units or less. Other workers have reported only traces of prolan in the urine of normal women.

These conflicting results are undoubtedly due to variations in technique. One of the most important is found in the particular physiological reaction taken as the measure of a unit, there being two commonly employed. These are first the direct effect on the ovarian follicle, second the indirect effect on the tubular tract, in particular the opening of the vaginal introitus and the production of the estrus type of vaginal spread. The latter appears more reliable but undoubtedly requires much more hormone than is needed to produce slight follicular changes.

Tests on the urine of normal women with extracts concentrated to about 5 to 10 units of prolan per liter when injected into infantile mice were found by us rarely to produce opening of the introitus and never full estrus. Evidence of partial ripening of the follicles was frequently present in the serial sections of the ovaries but was difficult to evaluate for comparative purposes.

A great increase of prolan excretion has been found in the presence of certain malignant tumors such as chorionepithelioma and teratoma and a slight increase has been reported in the presence of other new growths especially those of the female genital organs.

TABLE IV—REPRODUCTIVE HISTORY

	Cases with pain	Cases with hypertrophy	Cases with secretion
	156	31	47
	Percent	Percent	Percent
Single women	17	34	21
Married couples	45	23	25
Misconceptions	42	15	33
One or more children	9	20	26

(Zondek, 63, Hamburger) Besides these neoplastic conditions, an increase in prolan excretion occurs in women with marked degrees of ovarian deficiency particularly in the menopause (Zondek, 61, 62, Oesterreicher, Lassen and Brandstrup) In the amenorrheas of long standing in young women, the hormone has been occasionally found (Zondek, 60, Kaufmann and Muchlbock), but in the milder forms of ovarian hypofunction its presence has not been proved Besides these ovarian conditions prolan has been reported in cases with certain diseases of the central nervous system (Kraus) and migraine (Riley, Brickner, and Kurzrok) These points are of importance on account of the delayed and scant menstruation and headaches (Whitchose) noted in cases of the painful breast

4 *Scrum prolan* The test of Fluhmann (10), consisting of the simple injection of small amounts of blood serum into infantile mice is capable of demonstrating prolan when it is present in relatively large amounts in the blood stream Blood from normal women never produces a vaginal reaction, although possible follicular changes may be observed This test was likewise applied to a series of mastitis patients at weekly intervals Fluhmann (10) found prolan A in the blood of certain patients with prolonged amenorrhea, but obtained negative results in women suffering from the minor degrees of hypo ovarianism, as manifested by persistently delayed menses, scanty menses, and short periods of amenorrhea

5 *Examination of the endometrium* The uterine mucosa of any patient is an extremely sensitive indicator of her ovarian function, subject to none of the indirectness or loss in-

TABLE V—MENSTRUAL DISTURBANCES

	Cases with pain	Cases with hypertrophy	Cases with secretion
	156	31	47
	Percent	Percent	Percent
Normal menstruation	55.5	45	79.7
Disturbed after hysterectomy	11	19	10.7
Abnormal menstruation	25.1	36.2	50.0

herent in any method involving extraction and reinjection For that reason the evidence afforded by examination of endometrium from 31 cases of breast disease is especially important

#### RESULTS OF THE CLINICAL AND HORMONE STUDY

The evidence having a bearing on the etiology of chronic mastitis has been assembled under thirteen headings

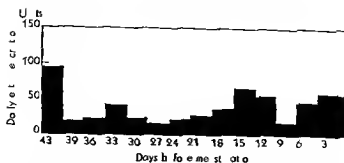
1 *Age incidence* The average age of the patients with pain was 30.7 years, those with hypertrophy 29.1 years and those with secretion 35.6 years

2 *Reproductive history* (Table IV) A contrast is afforded here between the cases with hypertrophy, nearly two-thirds of which were childless, and those with secretion, the great majority of whom had borne children

3 *Menstrual history* The frequency of menstrual disturbance in cases of chronic mastitis has heretofore been the chief clinical evidence of an ovarian dysfunction The total incidence of abnormalities in the frequency or duration of the menstruation is shown in Table V

a *Disturbances in the cycle of menstruation* (Table VI) were most common in the cases with discharge from the nipple and were usually of the delayed period or prolonged interval type

The daily excretion of estrin in the long cycle cases of this study averaged less than those with a regular rhythm (Tables IX A, IX B, IX C, IX D), but Zondek (60) in particular has reported the reverse in the so called polyhormonal amenorrhea in which there may be breast symptoms An example of the estrin



(Graph 1) Estrin excretion in the 43 days before menstruation of a patient with normal menstruation from the 1936-1937 cycle.

excretion in the prolonged cycle type is shown in graph 1 obtained from the following case:

**CASE 1.** S. W. Patient was admitted to hospital February 16, 1934. She was 34 years of age, married, and had two children, ages 7 and 3 years. Menstruation had always occurred at 6 to 8 week intervals with a 5 day normal flow and no dysmenorrhea. No discomfort had ever been felt in the breasts until 2 weeks before admission when a discharge was noted from the left nipple. Examination showed the breasts medium in size, dependent in shape, with wide slightly congested areolae and a moderate diffuse nodularity in both outer quadrants. A little oily discharge could be expressed from the left nipple, and at a later visit some was obtained from the right also. By vaginal examination the fundus was found slightly retroverted and enlarged with a moderately hypertrophied and eroded cervix and a slight enlargement of the right ovary.

**Hormone tests.** The excretion of estrin amounted to 1.743 mouse units in 43 days. The blood serum specimens tested by the Fluhmann method for estrin were negative. No increase in prolactin was found in 3 serum specimens or in 14 specimens of urine ex-

tracted by the tungstic acid procedure of Katzman and Doris.

**b. Disturbances in the duration of the menstrual flow.** (Table VII.) A decrease in the amount of the menstrual flow in the case of painful breast has been described repeatedly and was noted in 16.9 per cent of the patients of this series. It was also common with secretion from the nipple.

Since the scant periods have been cited as evidence of an underfunction of the ovary, it is interesting to note that the monthly estrin excretion in 6 women with periods of less than 3 days was not below the general average (Table I, B, I, C). An example of the estrin excretion in a woman menstruating for only 1 day is shown in Graph 2. The history of this case follows:

**CASE 2.** F. J. Patient was admitted to hospital February 2, 1932. She was married, age 26 years, with a history of one normal delivery 2 years ago and a therapeutic abortion 1 year before admission. Menstruation had formerly been of the type 28-30 days average, without pain, but since the birth of her child the periods had gradually been reduced to a very scant flow of 1 day's duration and became associated with headache, dizziness, and dysmenorrhea.

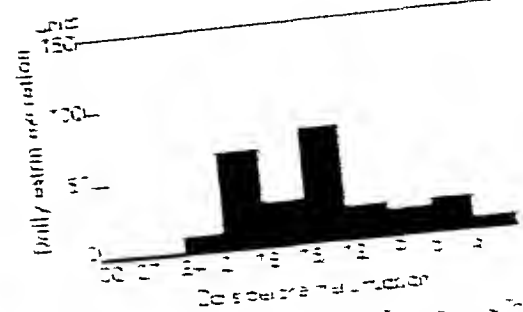
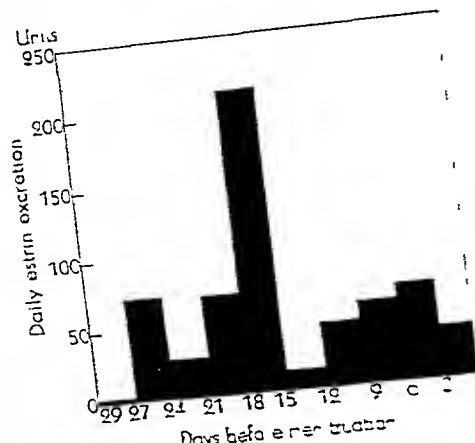
Three months after the delivery, her child's left breast had been removed by radical mastectomy for carcinoma. Three months before her admission to the Memorial Clinic there had been marked pain in the right breast chiefly premenstrual, with hypersensitivity of the skin of the axilla, right shoulder, and arm and occasionally of the right leg. In addition there was marked weakness of the right hand with general nervousness, anxiety, headache, and dyspareunia.

Examination showed the right breast small, dependent, and slightly nodular in the outer quadrants. The uterus was normal in size and position, with tenderness elicited by its manipulation. The adnexa were tender and the cervix large.

TABLE VI.—DISTURBANCES IN THE CYCLE OF MENSTRUATION

	Cycle length	Cycle length	Cycle length
	7-10 days	11-14 days	15-18 days
Normal	1	7	6
Am. str. test			
Low level—5 mm		9	
Low level—5			
Sh. cy level—fewer			
Cycle length			

# TAYLOR CHRONIC MASTITIS AND OVARIAN AND UTERINE DYSFUNCTION



Graph 3. Total estrin excretion in the cycle of a patient with painful breasts and a menstrual flow of 1 day. Exp 10. Total units 1750

these there was sufficient evidence that in or both ovaries had been removed. In the urine of all cases studied estrin was found in stable. An example of the cycle of estrin excretion after hysterectomy is shown in Graph 3.

Graph 2. Total estrin excretion in the cycle of a patient with painful breasts and a menstrual flow of 1 day. Exp 10. Total units 1750

The case was treated for 4 months with theelin without success and then selected for hormone study. No abnormalities were noted in the prolan or estrin content of either blood or urine.

**Hormone tests.** The excretion of estrin amounted to 1,756 mouse units in 29 days. Four blood tests (Frank and Goldberger 17) gave a single positive reaction in the third week. There was no evidence of increase in prolan in 3 specimens of serum or in C of urine extracted by the tungstic acid method.

Diminished menstruation cannot therefore be accepted as necessarily a sign of ovarian underfunction and may be dependent on a local pelvic or uterine abnormality. The dyspareunia and pelvic pain in this case will recall the fact noted in the first section of this paper that a diminishing menstruation has been ascribed to a chronic parametritis.

*c The appearance of breast symptoms after hysterectomy was noted in 12 cases. In all of*

Case 3. Patient was admitted to hospital September 19, 1931. She is married, 4 children, age 20, 18, 16, and 14. She has had a history of chronic pelvic pain, dyspareunia, and irregular menstruation. The symptoms of this case are in the nature of a burning pain in the lower abdomen, which is relieved by the following: 1. Heat, 2. Massage, 3. Exercise, 4. Change of position, 5. Rest. The patient has had a hysterectomy. The results of the hormone studies are given in the following table.

Following her operation the patient noted a decrease in pain, swelling of her breasts, and a return of menstruation. She has had a normal examination, and the results of the hormone studies were normal. She has been able to lead a normal life since her operation.

**Hormone tests.** The estrin content of her urine was 1756 mouse units in 29 days. Four blood tests (Frank and Goldberger 17) gave a single positive reaction. No definite increase in prolan was found in 3 specimens of serum or in C of urine extracted by the tungstic acid method.

TABLE VII—DISTURBANCE IN THE DURATION OF THE MENSTRUAL FLOW

	Cases with pain	Cases with dyspareunia	Cases with estrin
	3	3	3
	Per cent	Per cent	Per cent
Normal flow	77.7	66.7	77.7
Amenorrhea after hysterectomy	33.3	33.3	22.2
Short flow—less than 3 days	10.0	0.0	10.0
Long flow—more than 7 days	4.0	0.0	0.0

TABLE VIII—OVARIAN CONDITIONS - CONTRAINDICATIONS AT OPER. TIME

	Contra-indication	Contra-indication	Contra-indication
	1	1	1
	Per cent	Per cent	Per cent
Endometriosis	0.0	0.0	0.0
Chronic parametritis	0.0	0.0	0.0
Subacute parametritis	0.0	0.0	0.0
Adenocarcinoma	0.0	0.0	0.0
Normal	100.0	100.0	100.0



Fig. SC8397. Follicle cyst, deep film of the ovary in a case with pain during menstruation and secondary amenorrhea from the postoperative period.

Besides these benign cases 11 instances of breast cancer following hysterectomy have been observed by the writer during the last 5 years although no systematic search of the hospital file has been made. It is of incidental interest that Aschner maintains that a special tendency to cancer exists in the breasts of women who have had their uterus removed and includes this danger among his reasons for preferring myomectomy to hysterectomy for the treatment of uterine fibroids.

The reason for the development of breast disease after hysterectomy is not clear. An ovarian dysfunction based on cystic changes

developing in the retained ovary is a possibility although recent experimental work has not strengthened the accepted clinical belief in such a process (Sessums and Murphy). One study that of Kosakae Ohga and Okamoto has reported an increase in estrin excretion after hysterectomy perhaps due to the failure of the endometrium to utilize its quota of hormone. In 2 cases completely studied by us no increase in estrin excretion was found although high values were obtained in a third patient from whom however only a series of 8 discontinuous 24 hour specimens could be procured. It must finally be pointed out that the pelvic plexus of sympathetic nerves must unquestionably be affected by the removal of the uterus and the subsequent inflammatory and reparative processes. The sudden appearance of milk shortly after supravaginal hysterectomy with preservation of an ovary suggests therefore the possibility of a nervous as well as an endocrine factor in the following case.

CASE 4. C. B. Patient was admitted to the Roosevelt Hospital March 8, 1934. She was a married colored woman of 37 with one child 12 years of age and one miscarriage 17 years before admission.

A supravaginal hysterectomy was performed for a large fibroid uterus and a right salpingo-oophorectomy for fibrous and cystic degeneration of the ovary. Pathological sections showed a normal endometrium consistent with the twelfth day of the cycle and an adenomyosis of the inner layers of uterine musculature.

The postoperative course was normal but on the ninth day the patient reported that both breasts

TABLE IX. A.—TOTAL ESTRIN EXCRETION IN THE CYCLE OF 5 NORMAL WOMEN

Experiment number	Menstruation	Endometrial biopsy	Menstrual flow
		Normal	750
	5	Normal A	5
Repe		Normal B	5
		Normal	5
	6	Normal	
		Normal	5
Average			

TABLE IX. B.—TOTAL ESTRIN EXCRETION IN THE CYCLE OF 7 WOMEN WITH PAINFUL NODULAR BREASTS

Experiment number	Days	Physical pathology	Menstrual flow
5		Painful	7
6		Normal	5
		Normal tenderness	5
Amnorrheic		Painful	60
		Normal	600
		Recessed, amorphous only for postmenopausal cyst	55
Average			



were secreting milk in copious amounts. This continued for 8 weeks at which time the secretion was noted as diminishing and much thinner. A month later the patient returned complaining of pain in the left shoulder and neck. Examination showed a complete cessation of secretion from the breasts, a normal vagina without evidence of atrophy and a slightly enlarged left ovary.

**Hormone tests** On the sixteenth day after operation a 24 hour specimen contained 108 mouse units. Nine specimens examined during the next 6 weeks showed 24 hour excretions of 0 to 28 units. Seven specimens examined during this period for prolactin by the alcohol and tungstic acid methods showed no increase over the normal.

*d The connection between menstrual abnormalities and breast symptoms* was emphasized by the fact that in 82 patients the onset of the breast and menstrual symptoms was practically simultaneous. The menstrual change was a decrease in duration or frequency in 62 of these cases (Table XI).

*4 Ovarian pathology in cases of chronic mastitis* (Table VIII). From 21 cases observed at operation by the writer and from reports of the pelvic pathology of 47 further cases operated upon by other surgeons, one can find evidence of a relatively high incidence of cystic disease of the ovary.

For many years a condition sometimes termed pseudopregnancy and characterized by delayed menstruation with as a rule breast changes has been recognized. The symptoms are usually attributed to a persistent or cystic corpus luteum (Halban, Reeb), although Zondek (60) has shown that a persistent follicle

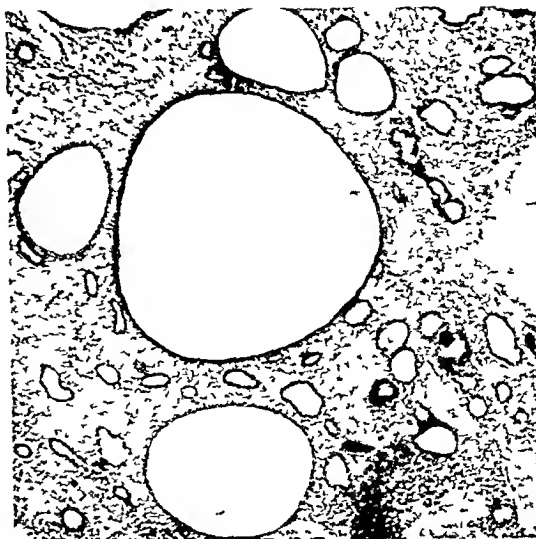


Fig 2 SD9573 Endometrial hyperplasia in a woman of 42 with normal breasts

may produce the same results. On account of an increase of folliculin in the urine and in the cyst of the ovary of his patient, Zondek (60) proposed the name polyhormonal amenorrhea for these cases. In another case with colostrum in the breasts and luteal cell cysts in the ovaries Kaiser found the Aschheim-Zondek test to be positive. Case 5 apparently belongs to this group.

CASE 5 H. G. Patient was admitted to the Roosevelt Hospital, June 19, 1933. She was a mar-

TABLE IX C—TOTAL ESTRIN EXCRETION IN THE CYCLE OF 6 WOMEN WITH PAINFUL BREAST HYPERTROPHY

Experiment number	Menstruation	Pelvic pathology	Mouse units
3	36 2	Salpingo-oophorectomy for cyst and inflammation	2095
44	30 1 1/2	Partial oophorectomy for cysts	2300
66 Repeat 44	28 2	Partial oophorectomy for cysts	2835
134	28 1	Salpingo-oophorectomy for cysts and inflammation	740
34	22 8	Possible endometrial hyperplasia	3900
111	31 5	Operation for salpingitis parametrial tenderness	1933
14	30 7	Parametrial tenderness	1765
Average			2170

TABLE IX D—TOTAL ESTRIN EXCRETION IN THE CYCLE OF 7 WOMEN WITH ABNORMAL SECRETION FROM THE NIPPLE

Experiment number	Menstruation	Pelvic pathology	Mouse units
16	41 4	Partial oophorectomy for cystic corpus luteum	1710
118	35 8	Normal pelvis	890
166	43 5	Cervical erosion	1740
4	Amenorrhea	Posthysterectomy—one ovary removed for cysts	1300
90	33 3	Parametrial tenderness	1300
86	26 3	Complete retroversion, partial prolapse	1550
39	24 4	Complete retroversion	Traces
Average			1430

\*Average does not include case number 39

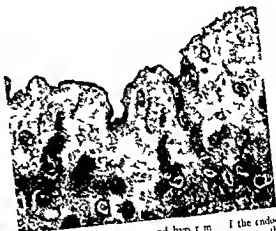


Fig 4 SC709 Ed m nd hyp r m f the endo-  
n t um n the t y f i t day f th cycl n case th  
pa tial p l ps f th uteru nd p me trual b e st pain.

meters of clear fluid had a hormone content of only 2.6 mouse units.

The nipple secretions irregularly of menstruation and pelvic discomfort were only partly relieved by the operation in spite of the removal of both tubes and the right ovary. Eight months after the operation the left ovary previously noted as atrophic had enlarged to nearly 2 inches in diameter.

The ovary with multiple small cysts was however a much commoner finding than the larger cysts of the type just described particularly in cases with breast pain and diminishing menstruation. This ovarian condition often termed cystic degeneration cannot at present be accepted as either the result or the cause of any known endocrine disorder. The cyst lining is usually composed of small inactive appearing cells and the hormone content of the cyst fluid is apparently low. The cystic ovary itself is often small and fibrotic and might as a rule be well under normal size were it not for the bulk of the cysts. The association of the cystic ovary with inflammation (Witherpoon) or congestion (Moench) was evident in a number of the present cases.

Four cases in which cystic ovaries had been reported at operation were studied and no hormone abnormalities noted (Table IX, C). In 1 of the 4 patients a palpable cystic ovary was present during the period of the tests the curve of her estrin excretion being shown in Graph 4 and the history of her case being given below.

Fig 3 SC690 Ed m f th f m t um n the  
f th ut u d p f th y i n p t t th t  
nd w l l g f th b east

ed oman f 24 w th 1 child 9 years of age Men-  
struation had formerly been of the type 25 4  
a er ge with slight discomfort but for 6 m aths  
the periods had been recurring at 5 to 7 week inter-  
vals and last ng but 1 lay for 2 years the fat ent  
l a f been under treatment for pel c inflammation  
l i e a n f d u r n g th s time there had been a bi-  
lateral milk secretion from the nipples and pre-  
menstrual pain and swelling of the breast. She be-  
gan to menstruate on the day of the operation after  
a 53 day inter al.

The pathologic findings at operation was as follows:  
The right salpinx with adenomyosis of the uterine  
cervix endometrium is and papillomas of the  
ovary follicle an corpus luteum cysts of the ovary  
(Fig 1). The right ovary measured 4 by 4 by 4 centi-  
meters and contained multiple cysts with small  
illous papillomas. The left ovary was small and  
adherent and measured by 0.5 centimeters.  
A cyst in the right ovary containing 80 cubic centi-

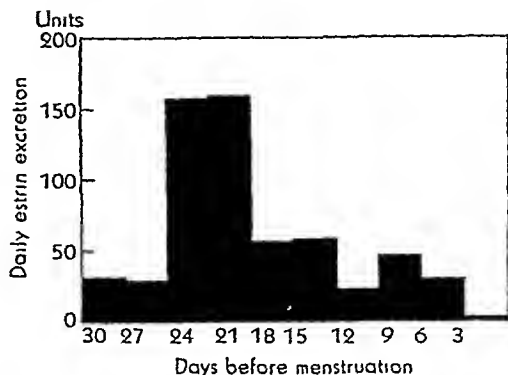
**CASE 6 A J** First examination January 13, 1932 Patient was a married woman of 29, with 1 child 6 years of age Menstruation had always been of the 28 day type, formerly of 7 but now of 4 days duration and decreasing somewhat in amount, without dysmenorrhea The breast symptoms dated from a pelvic operation performed 3 years before admission, when the right tube and ovary and part of the left ovary were removed for multiple follicle cysts Since that time there had been a regular 2 day bilateral premenstrual pain in the breasts with a diffuse soreness over the entire surface of the anterior chest In addition there had been pain in the left leg, pain in the left abdomen, a mass in the left pelvis, dyspareunia, nervousness, frigidity, and epigastric distress

Examination showed the breasts small, dependent and slightly nodular The fundus was of normal size and in midposition, and the cervix eroded with endocervicitis In the region of the left ovary was a mass 5 inches in diameter, readily palpable above the symphysis The patient remained under observation for 2½ years with examination of the pelvis every 4 months The size of the cyst rapidly diminished after the first examination until only 1½ inches in diameter, but enlarged again to nearly its former size in June, 1933 After that, several fluctuations in size occurred The local pelvic symptoms and the indigestion were worse when the cyst was the largest, but no correlation between the severity of the breast symptoms and the size of the cyst was evident

The hormone tests for estrin and prolan in the blood and urine performed during a month of severe breast symptoms but with the cyst relatively small disclosed no significant abnormalities

In 5 cases the fluid of the ovarian cysts was assayed for its estrin content In 1 there was no hormone and in 3 only small quantities The fifth case with profuse nipple secretion was found to have a cystic corpus luteum which yielded 20 mouse units from its 8 cubic centimeters of fluid content In contrast with these 5, the follicle cyst in a patient with a typical case of endometrial hyperplasia (Fig 2) without breast changes yielded 90 mouse units

**5 The endometrium in cases of chronic mastitis** In 31 cases, sections of endometrium were available for study The 23 sections from cases with pain were normal except for 3, 2 of which showed a suggestion of glandular hyperplasia and 1 a carcinoma of the corpus The 2 sections of endometrium from cases with hypertrophy of the breast and the 6 from cases with secretion were all normal In the 20 cases in which the phase of the cycle at which the curettage was performed was on



Graph 4 Total estrin excretion in the 30 day cycle of a patient with painful breasts and cystic ovary Exp 57 Total units 1,741

record, the endometrium showed the expected morphology

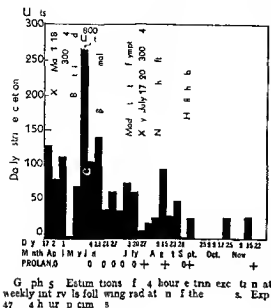
These results are important for, if chronic mastitis were due to a persistent hyperactivity of the ovary, one would expect a more or less constant association of the breast disease with endometrial hyperplasia Actually, the clinical aspects, particularly the age of the patients and the menstrual patterns, are quite dissimilar Only in elderly women with granulosa cell tumors have breast effects been reported in association with endometrial hyperplasia (Habbe, Muellerheim)

**6 Tests for the follicle hormone** It has been noted that Frank (15) found that the normal monthly excretion of estrin in the urine varied from 800 to 1,500 mouse units, and Siebke (51) from 200 to 2,000 The five determinations made on normal women in this study showed a wider range namely, 760 to 3,150 units

The total monthly excretion of estrin was studied in 7 cases with pain and nodularity of the breasts, having various types of menstrual cycle and various pelvic lesions (Table IX B) The monthly rates varied from 600 to 2,930 mouse units, the average being 1,335

The excretion of estrin was similarly studied over a month's period in 6 cases of breast hypertrophy (Table IX C) The monthly rates varied from 740 to 3,900 mouse units, the average being 2,230

The monthly excretion in 6 cases with secretion from the nipple varied from 890 to 1,740 mouse units, the average being 1,480



(Table IX, D) In the seventh case studied during a course of deep X ray therapy to the breast there was an almost complete absence of hormone

On account of the greater length of the menstrual cycles in the secretion group a perhaps better contrast is obtained by noting the average daily excretion. This for normal women had been found to be 56 mouse units. For the three different types of breast disease the average daily output was as follows: by hypertrophy 76 units, painful nodularity 50 units, secretion 42 units. Although these averages are based on the assay of 232 specimens it cannot be maintained that the differences are significant.

The estrin of the blood was studied by weekly tests by the technique of Frank and Goldberger (17) in 19 cases. The presence of the hormone was demonstrable at least once in 1 of 4 cases with pain, 7 of 9 cases with hypertrophy, and 3 of 5 cases with secretion.

**7 Tests for the presence of prolactin** The prolactin in the urine was studied by the examination of a total of 171 specimens from 14 cases: 4 with pain, 4 with hypertrophy, and 6 with secretion. Variable methods of extraction and high degrees of concentration in some cases to show as little as 5 to 20 units per liter failed

to give positive vaginal reactions. Minor changes in the ovarian follicles were noted when the higher concentrations were used, but these were decidedly less marked and less frequent than those commonly obtained from women in the menopause. Only in 3 cases with nipple secretion associated with delayed menses were there slight indications of an increase in prolactin excretion.

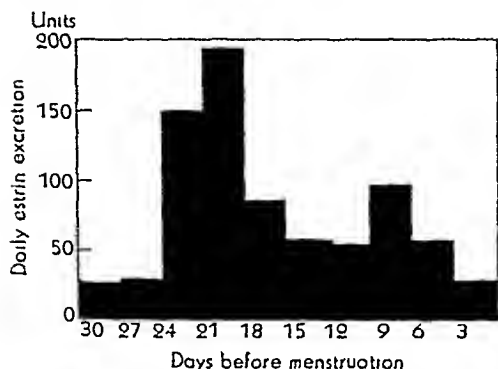
The presence of prolactin in the blood serum was sought by weekly tests using the Fluhmann (11) technique in 14 cases, 6 with pain, 4 with hypertrophy, and 3 with secretion. Some evidence of follicular ripening was apparently attained from several cases but in none was prolactin definitely shown through the production of vaginal signs of estrus.

**8 The effects of radiation of the ovaries** In 12 cases the effect of pelvic X ray and in 3 of radium from the uterus upon the clinical state of the breast was studied. In all but 1 there was immediate evidence of improvement in the pain and swelling and the nodularity of the breast tissue. In 6 cases in which the radiation dosage was sufficient completely to suppress the ovarian function the improvement was permanent, whereas in 8 in which smaller doses were given there was a later partial return of symptoms.

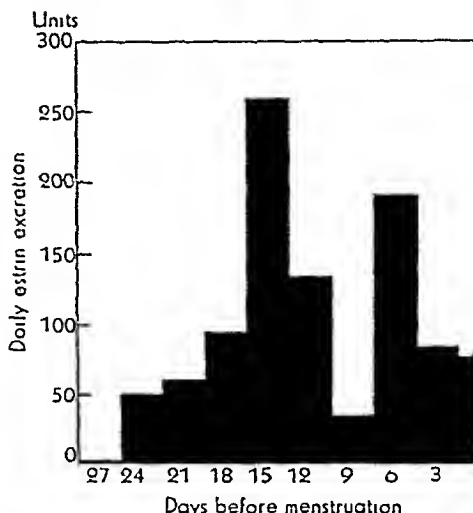
In 2 cases in which X ray of the pelvis was given the hormone excretion was studied for 3 months after treatment by weekly examination of specimens. In both the improvement in the breast symptoms corresponded with a decided drop in the rate of estrone excretion and by the appearance of prolactin in the urine.

The effect of X ray on the ovaries is illustrated in the following case:

**CASE 7** R. L. W. was admitted to the hospital November 8, 1932. She was a married woman of 42 with 3 children, the youngest aged 7 years. Tenderness and diffuse nodularity of the breasts and a little only secretion from one nipple had developed 6 months before admission or 7 years after a supravaginal hysterectomy for fibroids. Following four treatments each of 300 r units to the pelvis there was a marked improvement in breast symptoms. Two and a half months after the first series a second with the same dosage was given on account of a moderate return of the breast discomfort. Following the second series the breast symptoms subsided entirely, prolactin appeared in the urine, and only traces of estrone were excreted (Graph 5).



Graph 6 Total estrin excretion in the 30 day cycle of a patient with bilateral painful hypertrophy of the breasts and a menstrual flow of  $1\frac{1}{2}$  days Exp 44 Total units 2,300



Graph 7 Total estrin excretion during the 28 day cycle following X-ray of the ovaries Exp 66 Total units 2,830

In 2 cases an entire month's excretion of hormones was studied both before and after radiation of the pelvis. The improvement in breast symptoms was again correlated with a great decrease in estrin excretion. The history of 1 of these cases is as follows:

**CASE 8** R. K., was admitted to the hospital October 1, 1931. She was 33 years of age, married but sterile. Menstruation had formerly been of the type, 28, 4, average, with occasional dysmenorrhea, until 4 years ago, when she was operated upon for a uterine fibroid and cystic ovary. Following the operation the periods became reduced to  $1\frac{1}{2}$  days, while the breasts enlarged and developed a severe premenstrual tenderness.

During the month from April 4, to May 3, 1933, the patient's urine was collected and found to contain a total of 2,300 mice units of estrin (Graph 6). The blood tests for estrin (Frank and Goldberger) yielded positive reactions in the first and third week. No prolactin was demonstrable in 10 urine specimens by the alcohol precipitation method or in 4 specimens of serum.

From June 5 to 8, the patient received 4 X-ray treatments to the pelvis of 200 r units each.

From June 6 to July 3, the patient excreted 2,830 mice units and had her usual menstrual period preceded by slightly reduced breast discomfort (Graph 7).

Thereafter all breast symptoms rapidly subsided and no further period occurred for 11 months.

From August 29 to September 28, the estrin excretion was studied for a third time. Only traces of estrin were discovered, the total amounting to perhaps 50 units for the month. With the return of menstruation on June 27, 1934 there was a slight recurrence of the breast tenderness.

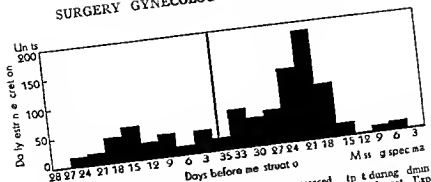
The effect of radiation of the ovaries on the secretion of milk was less definite. In 2 cases,

the disappearance of the discharge required 3 to 4 months and in one instance milk continued to appear for 5 years after a single high voltage treatment to the pelvis in an amount to produce erythema of the skin.

Roentgenographs of the sella turcica in 3 cases of abnormal milk secretion failed to demonstrate any pituitary hypertrophy, and radiation of the pituitary by high voltage X-ray in one case failed to affect the symptoms.

**9 The effect of treatment with ovarian hormones** Improvement in the painful breast following the use of ovarian extracts has been claimed (Cutler, Leriche, Whitehouse). The fact that these results have been observed even after the administration of tablets of the dried gland, containing what now must be regarded as negligible quantities of hormone, indicates that the improvement noted was not due to the specific therapy. Treatment of either the painful or the secreting breast at the Memorial Hospital by the injections of potent preparations of the ovary or anterior pituitary has not produced constant effects.

In the oophorectomized woman the administration of the ovarian hormones has led to swelling of the previously atrophied breast and to some painful sensations (Werner and Collier, Loeser). On the other hand, the ad-



Graph 8. Total estrone excretion of two cycles showing increased excretion during the last half of the first cycle and the first half of the second cycle. Total estrone in first cycle 740 mouse units; second cycle 2185 mouse units.

ministration to menstruating women with chronic mastitis of even very large quantities of hormone sufficient to produce a demonstrable rise in the rate of estrin excretion has not caused in our experience any increase in the breast symptoms. The following case is illustrative.

**CASE 9.** A P. Patient was admitted to the Roosevelt Hospital February 10, 1934. She was a woman of 35 with a history of encephalitis lethargica at the age of 13 and of one miscarriage a pelvic admission. A year after the miscarriage a pelvic operation had been performed for salpingitis and a cystic ovary. Menstruation until the miscarriage had been of the type 28 3 average without pelvic or breast pain but since then the periods had become totally irregular very scant and preceded by 2 weeks of pain swelling and the development of lumps in the breasts. The breasts had grown progressively larger and before the periods developed petechial hemorrhages in the skin above and within the areolae.

The patient was admitted to the gynecological ward of the Roosevelt Hospital on February 10, 1934. She was observed for 12 days before her period during which time her suffering was intense enough to require the regular administration of codeine. The hemorrhagic spots appeared 5 days before her period and are shown in Figure 12 of Part I.

During the 28 day cycle beginning February 22, 1934, no treatment was given beyond rest in bed support of the breasts and sedatives. Biopsies were taken on March 8 and March 22, 14 days before and 2 hours after the onset of menstruation respectively (Figs 13, 14 of Part I). There was definite improvement in the breast symptoms during this month which could only be attributed to the physical and mental rest afforded by the stay in the hospital. Hormone tests. The excretion of estrin during this month totaled 740 mouse units (Graph 8). There were four negative blood reactions (Frank and Gold

berger) the last coinciding with a weakly positive Fluhrmann test for serum estrin. There was no evidence of an increase in prolactin in five specimens of blood serum or in ten urine specimens extracted by the tungstic acid method.

The patient's next cycle lasted 34 days only 14 of which she spent in the hospital. During this time she received a total of 132,000 mouse units of a commercial preparation of estrin in oil. The subsequent period was associated with a greatly reduced pelvic and breast discomfort and there were no hemorrhagic spots. The urinary excretion of estrin rose to over 2185 units, the patient failing to submit two of her specimens (Graph 8).

**10. Evidence of an associated pelvic congestion or parametritis.** Reasons have been given in the first sections of the paper why a lesion of the pelvis having an effect upon the breast by way of the nervous system must be given consideration. Much of the data already discussed including the variations in the menstrual flow and the fibrotic or multicystic ovary might be interpreted either as evidence for a glandular or neurovascular disturbance. The conditions to be discussed under the present head (Table V) have all been described by one or more previous writers as the causes of pelvic congestion or parametritis and each has also been previously reported in association with breast symptoms. The evaluation of their importance is concededly difficult since the conditions are such that instances of each would be found in the examination of any large series of women. Certain special characteristics of these conditions as they occur in the present series, their high incidence and the frequent simultaneous appearance and disappearance of breast and

pelvic symptoms, are points in favor of a more than accidental association

*a An existent or previous history of pelvic inflammation* was noted in a total of 27 cases. These represented 12.5 per cent, 3.2 per cent, and 6.4 per cent of the cases with pain, hypertrophy, and secretion, respectively. A striking feature of these cases was that many appeared not to have been of gonorrheal origin but to have followed an abortion. The following case is illustrative.

CASE 10 G. S., was admitted to the hospital August 29, 1933. She was a married woman of 23, by occupation a night club hostess. Five years before admission she had suffered a severe pelvic infection following an abortion. For a year after that she was treated for pelvic inflammation and then operated upon. Both tubes, which were adherent and acutely inflamed, were removed.

During the last 5 years the patient's periods had been preceded by 10 days of marked pain and swelling of the breasts. Menstruation was, however, irregular, occurring every 2 to 4 weeks and lasting from 3 to 7 days. Additional symptoms were diffuse premenstrual pelvic pain, abdominal distention, indigestion, leucorrhea, and dyspareunia. Examination showed the breasts of medium size, dependent, nodular in the outer quadrants and exceptionally tender. The uterine fundus was forward and fixed with attempted motion causing severe pain. The ovaries were a little swollen and very tender. The cervix was moderately eroded and discharging profusely.

Hormone tests showed a 31 day excretion of 1,955 units of estrin with four negative blood specimens. There was no evidence of an increase in prolactin in 4 specimens of serum tested by the Fluhrmann method or in 10 urines extracted by the tungstic acid method.

The patient was treated for a year in the gynecological clinic, at the end of which time both breasts and pelvic symptoms were greatly improved.

*b Cases of typical "chronic parametritis"*  
Besides these cases there were 62 others with various types of pelvic pain and uterosacral or broad ligament tenderness which appeared to correspond closely to the condition, described by Freund, as parametritis and with which he noted painful nodules in the breasts. These represented 26.2 per cent of the group with breast pain, 16.1 per cent with hypertrophy, and 17.0 per cent with secretion. The following case is a good example.

CASE 11 R. S. First examination was made September 26, 1933. Patient was 30 years of age,

TABLE X—PELVIC LESIONS FOUND IN PATIENTS WITH BREAST DISEASE

	Cases with pain Per cent	Cases with hypertrophy Per cent	Cases with secretion Per cent
Pelvic inflammation	12.5	3.2	6.4
Parametritis	26.2	16.1	17.0
Retroversion	36.6	10.0	44.0
Endocervicitis	45.2	22.6	43.9

married for 12 months, but unable to conceive. Menstruation before marriage had been of the type, 28.4, average, with moderate pelvic discomfort and a slight premenstrual swelling of the breasts. Since marriage menstruation had been every 4 weeks lasting 4 days, with very severe lower abdominal discomfort. In addition the patient suffered from constant backache, lower abdominal pain, discomfort on sitting down, dysuria, and dyspareunia to the extent of making coitus practically impossible. During this same period of 12 months the premenstrual breast pain and swelling had greatly increased and there had been a permanent enlargement of the breasts to the extent of increasing the circumference of the chest, as measured by necessary changes in the brassière, 3 inches.

*Examination.* The breasts were medium in size, pendulous, with a moderate amount of nodular, glandular tissue in the outer quadrants. The uterine fundus was normal in size and position but an extraordinary degree of tenderness was elicited on its attempted motion. The cervix was without erosion but secreting great quantities of clear mucus. The thyroid was a trifle enlarged.

The patient was observed at intervals for a year. The pelvic symptoms for which she primarily sought relief were always worse for several days after sexual intercourse and during 1 month that she spent by herself in the country she was largely free from both breast and pelvic complaints. In spite of numerous relapses, the tendency was toward improvement and at the time of writing she is nearly symptom free and 3 months' pregnant.

The clinical course and the subsequent pregnancy indicate that this in spite of the severity of the symptoms was a process quite distinct from the usual infectious salpingitis. An example of a perhaps later stage of the disease with decreasing menstruation has already been described in Case 2.

*c Retroversion of second or third degree or partial prolapse of the uterus* was noted in 91 cases. These represented 36.6 per cent, 10.0 per cent, and 44.6 per cent of the cases with pain, hypertrophy and secretion, respectively.

The relation of uterine malposition to breast disease may appear remote. Nevertheless there are three articles in the literature reporting the cure or improvement of mammary pain by the reposition of a misplaced uterus (Ayler Hastrup Miller). It is known furthermore that a uterus in retroversion or partial prolapse may affect the pelvic circulation to the extent of producing broad ligament varices and possibly many secondary changes. In the present series there were 14 cases with retroversion and breast disease in which the pelvis was observed by the writer at the time of celiotomy. The uterus in these cases was regularly found swollen and congested. Histological evidence suggesting a vascular disorder in the pelvis is found in a few cases with exceptional edema and hyperemia of the endometrium and ovary (Figs 3, 4). That this general pelvic hyperemia may affect both the ovaries and the autonomic nerves of the pelvis must be admitted.

*d Endocervic is erosion or infected laceration* were noted in 114 cases representing 45.2 per cent, 22.6 per cent and 48.9 per cent of the 3 groups of cases. These are minimum figures for among those counted as normal are 27 cases not examined and 56 cases incomplete to the extent of their being no record of the condition of the cervix.

The group with cervical disease has been placed in the pelvic congestion group for two reasons. First a hypersecretion of the cervical glands is probably often the result of pelvic hyperemia and may be its only symptom. On the other hand parametrial infection may arise through the lymphatics from a diseased cervix. In the literature are also to be found numerous reports of hypertrophied and infected cervixes in association with breast disease and the cure of the latter after treatment or amputation of the cervix (Aitken, Ronth, Copland, Miller).

*e Relationship between certain breast conditions and disorders of the sexual function* has been described repeatedly in the literature (Rosenthal, Glass, Samuel, Witthauer, Ruz, Dickinson). No complete statistical survey of this aspect could be made in this series, but a few points are noteworthy. In 22 patients the symptoms developed at the time of mar-

riage. Twenty three women complained of dyspareunia. Of 76 women questioned the majority were practicing contraception by methods which were possible causes of pelvic congestion. The relationship between a sexual difficulty and the development of physical changes in the breast is well illustrated in the following case.

**CASE 12. N. D.** Patient, as admitted to hospital October 7, 1931. She is 28 years of age, married for 1 year without pregnancies. Six months after marriage the patient had first noted premenstrual pain, swelling and the appearance of lumps in the breasts. Examination showed the breasts medium in size and dependent with an extraordinary diffusely swollen appearance, dilated veins on the surface and large, partly circumscribed areas of induration in both outer quadrants. The pelvis was normal except for a hypersecretion of the cervix.

At the patient's second visit she volunteered a long story of psychological difficulties in childhood, resulting she believed in a complete inability to adapt herself to normal marital relations. Temporary separation from her husband was under consideration. Two months later the patient reported by letter that she had adopted this course and that her breast trouble had completely disappeared.

*f The time of appearance of breast symptoms.* In 92 cases the onset of breast symptoms was traceable to a definite incident in the patient's life which furnished a reasonable cause for the development of a pelvic congestion or parametritis. Thus the symptoms began at marriage in 25, after abortion in 12, after childbirth in 22, following pelvic operation in 26, and coincident with pelvic inflammation in 7. In 34 cases a pelvic condition of this type was suggested by the beginning of a secondary dysmenorrhea at or near the time of onset of the breast symptoms (Table XI).

*11 Dysmenorrhea and breast symptoms.* Primary dysmenorrhea was present in 52 per cent of the 50 unmarried women of the series representing 55.5 per cent of the 36 cases with pain, 60 per cent of the 10 cases with hypertrophy but none of the 4 cases with secretion. This symptom occurring with breast pain is subject to various interpretations. For on the one hand dysmenorrhea has been attributed to an increased contractility of the uterine musculature from follicular hormone stimulation (Kraus, Reynolds, Novak) and on the other it has been successfully treated by sec-



tion of the presacral nerve (Cotte, Counsellor and Craig)

12 *The association of thyroid disorder with breast disease* The coincidence of thyroid disorder and various types of pelvic disorder is well known. There may be, as is the case with the breast, a premenstrual thyroid enlargement as well as an apparent relationship to various menstrual anomalies, certain pelvic lesions and possibly sexual activity. In the present series there were noted 21 cases with definite thyroid enlargement and minor degrees of fullness were quite common, especially among the younger women. In 5 cases, 4 with pain and 1 with hypertrophy of the breasts, the thyroid abnormality was the only criterion for the classification of the case. The treatment of 2 cases by irradiation of the thyroid was followed by subjective improvement in the breast condition.

13 *Psychic factor in breast disease* Repeated reference has been made in the literature to the excitable temperament of patients with the painful breast and the development of symptoms at times of nervous stress (Taylor). Corroboration of this was found in many instances in the present series in which symptoms were made worse during periods of anxiety resulting from economic worries, the illness of relatives or marital difficulties. Pelvic symptoms from similar causes have been reported (Meyer-Ruegg). The following case illustrates the rapidity with which the breast, presumably through its vascular system, may in predisposed individuals respond to trivial psychic stimuli.

CASE 13. D. T., was admitted to hospital March 15, 1933. She was unmarried, aged 18. Menstruation, which had begun at 13, was slightly irregular, of the 21-28 day type, lasting 6 days and associated with backache, headache, abdominal pain, and cramps so severe as to cause confinement to bed.

The breasts began to develop at the age of 12 and have continued to grow. For 10 days each month there was a premenstrual swelling with severe pain radiating down each arm. In addition the patient reported that throughout the month she frequently experienced abrupt swelling of the breasts with any excitement such as a trivial accident at the dinner table, an unexpected visitor, or an anticipated social event.

Examination showed a slender white girl with enormous pendulous breasts, out of all proportion

TABLE VI—INCIDENTS ASSOCIATED WITH THE ONSET OF BREAST SYMPTOMS

	Cases with pain	Cases with hypertrophy	Cases with secretion	Total
Marriage	17	7	1	25
Abortion	10	0	2	12
Childbirth	10	0	6	22
Pelvic inflammation	6	1	0	7
Gynecological operation	13	7	6	26
Menstrual change	50	13	19	82
Onset of dysmenorrhea	6	3	5	34

to her age and size. The breast tissue was diffusely nodular throughout, the nipples normal, the areolæ wide and dark. Rectal examination revealed a small, anteverted uterus. The thyroid was slightly and symmetrically enlarged. The urine estrin excretion was normal but the blood test gave a positive reaction in the specimens of both the first and third week.

#### DISCUSSION AND CONCLUSIONS

The general conclusion of this study is that a certain minimum activity of the ovary is necessary for the development of chronic mastitis but that no specific hyperfunction or hypofunction of the ovary is at present demonstrable. This result is contrary to hopes entertained at the beginning of the work and contrary to what might have been expected from the known proliferative effects of the ovarian hormone on the breast tissue.

Certain exceptions and reservations must be made. In one small group of cases in which swelling of the breast, sometimes with secretion, develops in the presence of a persistent follicle or corpus luteum cyst, a hormone cause is probable, but the clinical aspects of this condition are different from that of the common type of chronic mastitis with painful outer quadrant induration. It is not unlikely that other unrecognized reactions of the breast to certain hormone states may exist.

Even for the common type of mastitis, however, it must be conceded that the present method of study has not exhausted the possibilities of a hormone cause. Present technical methods for the clinical determinations of estrin and prolactin are far from perfect and no satisfactory test exists for the quantitative

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study of the corpus luteum hormone in body fluids. A very slight disturbance of gland function might cause hyperplasia in the breast when active over a considerable number of years and yet not be obvious when studied by relatively crude laboratory methods over a month's time. Irregularities in the peaks of production or excretion of estrin may further more have a significance quite aside from the total quantities chiefly discussed in this paper. Finally it is possible that the abnormal estrin effects on the breasts may be the result of local conditions such as an increased responsiveness to normal quantities of hormone or a tissue as the result of local hyperemia or a tissue concentration of the gland substances bearing no relation either to the actual activity of the ovary or to the amount of hormone in the blood stream.

With these reservations the following summary is offered of the present knowledge of the conditions under which chronic mastitis is found to develop.

## A. THE PAINFUL NODULAR BREAST

1. An active ovary producing estrin must be present.

2. The painful breast is limited to women before the menopause and after puberty.

b. The pain and nodularity improve with X-ray and surgical castration such improvement paralleling the fall in estrin excretion in the urine.

There is no indication of an extensive ovarian activity.

a. The histological structure of the painful breast does not show the uniform epithelial proliferation of a hormone produced hyperplasia.

b. The 7 cases studied did not contain any excess of estrin in the urine or blood and in several cases the estrin excretion was quite low.

c. The endometrium in cases of the painful breast does not show the hyperplasia to be expected with hyperactivity of the ovarian follicle.

d. Administration of considerable quantities of ovarian hormone to patients with the painful breast does not increase the severity of the symptoms.

3. There is no indication of an underfunction of the ovary.

a. The average excretion of estrin in 7 cases which were studied was within normal limits and in several of these cases rather high values were found.

b. The scant menstruation noted in 16.9 per cent of the women with the painful breast was the chief evidence for the underfunction theory but the estimation of the estrin excretion in such cases gave normal values.

c. Consistent results have not been obtained in this clinic by the treatment of the painful breast with estrin or the ovary stimulating hormone of the anterior pituitary.

4. A dysfunction of the ovary remains a possibility which cannot be entirely excluded.

a. Delayed or irregular menstruation which must be accepted as a sign of a disturbed ovarian function was present in 13.7 per cent of the cases.

b. Irregularities in the curves of estrin excretion or of blood concentration may even usually be shown to have some significance but knowledge for their interpretation is at present lacking.

c. The multicystic ovaries observed in many cases also may be taken as evidence of a disturbed ovarian function but they may be looked upon as well as the result of vascular congestion in the pelvis.

5. A corpus luteum disorder cannot be excluded since tests do not exist for studying the blood and urinary levels of this hormone.

a. The frequency of normal menstrual rhythm the histological evidence of a regular endometrial cycle and the rarity of evident disease of the corpus luteum in patients operated upon are evidence against this factor.

6. There is no indication of a hyperactivity of the anterior pituitary.

a. Prolan appears in the urine only in cases of pronounced underfunction of the ovary which is never found with the painful breast.

b. An increase in prolan in the urine comparable with that taking place in the menopause has been excluded by the present series of studies.

c. The appearance of prolan in the urine after X-ray of the ovaries occurs at the time of improvement of breast symptoms.

7 *The painful breast has from the clinical aspect a large nervous element*

a The pain and tenderness are more marked than are to be expected in an endocrine produced glandular hypertrophy

b The pain radiates to the arm, neck, axilla and lateral body wall and may be associated with hyperesthesia of the skin of the whole thorax

c The pain and swelling in certain cases are produced or become worse during periods of nervous tension and may even develop abruptly within a few minutes after a nervous shock at any time in the monthly cycle

d Various associated nervous complaints are described by the patient including insomnia, anxiety, palpitation, blurring of the vision, mucous colitis, and headaches

e One case report exists in the literature of the disappearance of the premenstrual breast symptoms in one breast after the destruction of the thoracic sympathetic of that side

8 *A local state of vascular congestion is a prominent feature of the painful breast*

a The gross appearance of the painful breast before menstruation with its hyperemia of the areola, venous dilatation and increased weight alone suggests hyperemia

b The histological signs of this vascularity may be demonstrated in the "edema" of the lobule

c The relief afforded by the onset of menstruation is usually too rapid to be explained as the result of epithelial regression

d The sudden appearance of pain and swelling in the middle of the cycle in certain cases cannot be ascribed to epithelial proliferation

e Simple support of the breast often causes considerable amelioration of symptoms

1 In one case described with pain and hypertrophy, petechial hemorrhages occurred regularly before menstruation in the skin about the areola

9 *The coincident gynecological lesions and menstrual disturbances have a possible significance as evidence of an associated vascular congestion and tissue edema in the pelvis*

a The common pelvic lesions are classifiable as adnexal inflammation, parametritis, retroversion, and cervical infection

b The onset of pelvic symptoms and breast pain after marriage, abortion, or pelvic infections is significant of parametrial congestion or inflammation

c The scant menstruation may be regarded as the effect of the secondary fibrosis in the pelvis described by many writers as the end result of chronic pelvic congestion

d The edematous, cystic, and fibrotic ovaries may have a similar cause

One may offer the following provisional conclusions on the cause and nature of the painful, diffusely nodular type of mastitis as follows

1 The ovarian hormone is certainly a necessary factor, but it has not been possible by present laboratory methods to demonstrate any specific abnormality of ovarian or anterior pituitary function. It is, however, possible that refinements in technical methods may eventually reveal a definite endocrine disturbance

2 The conception of the disease as primarily a vascular disturbance with changes occurring in the interstitial tissues of the breast based on abnormal nervous stimuli explains many of the clinical aspects of the disease. Such a view can only be accepted with caution, however, because it requires the assumption of a physiologic mechanism yet largely undemonstrated

#### B BREAST HYPERTROPHY OCCURS IN AT LEAST TWO FORMS

1 In one group in which there is a simple painless enlargement of the breasts or relatively uniform consistence an endocrine factor is clearly prominent. This includes the hypertrophy developing in childhood and in old women in the presence of the specific ovarian neoplasms, such as the granulosa cell tumors and teratomas. Breast swelling has also been observed in the presence of persistent corpus luteum and follicle cysts and ascribed to a polyhormonal amenorrhea. Breast hypertrophy after hysterectomy may, in some cases, have a similar basis

2 The painful hypertrophies of this study were not of this type and resembled closely the tender nodular breasts, both in regard to their physical characteristics and the condi-

tions under which they occurred. Hormone studies of a series of these cases gave normal blood estrin values, rates of monthly excretion of estrin a little higher than in the cases of the painful breast but still probably within normal limits and no increase in prolactin excretion. The ray of the ovaries led to a disappearance of the pain and to a reduction in the size of the breasts but the use of ovarian hormone by mouth or hypodermic was ineffectual. The coincident pelvic lesions and the incidents associated with the onset of the breast enlargement were in general the same as those found for the painful breast.

The conclusions in regard to the causes of this type of hypertrophy must be similar to those for the painful nodular breast.

#### C. ABNORMAL SECRETION FROM THE NIPPLE

The local physical characteristics as well as the conditions under which abnormal nipple secretion occurs seems to distinguish it somewhat from the two preceding groups. The average age of these patients was higher, the proportion of women with preceding pregnancies was much greater, menstrual disturbances were more frequent, particularly in the form of delayed menstruation, the average daily excretion of estrin was lower, the secretion did not disappear at once after the ray of the ovaries.

In many cases, however, the characteristics of the painful breast were present, notably the cyclical pain and swelling, the diffuse nodularity and certain coincident pelvic lesions.

It is concluded that the cases with abnormal secretion are a heterogeneous group, the following representing a possible classification of these:

1. Cases with a non-specific discharge, serous, sanguineous or purulent from local disease of the larger ducts.

2. Cases reported in the literature with a definite nervous factor either in the form of direct stimulation of the nipple or a central nervous system disease such as tabes dorsalis or syringomyelia.

3. Cases reported in the literature with definite evidence of endocrine disease such as the instances of amenorrhea with follicle or corpus luteum cysts. To this group may be

long the cases of temporary secretion in the early menopause theoretically ascribable to the sudden decrease in ovarian activity or the increased function of the anterior pituitary.

4. In a large group of cases one is forced to maintain the alternative theories noted for the other two types of breast disease, namely an as yet undetermined variety of endocrine disturbance or a little known form of neurovascular disorder.

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# REPRODUCTIVE EFFICIENCY BEFORE AND AFTER THE BIRTH OF MALFORMED CHILDREN

## A STUDY OF 405 CONSECUTIVE FAMILIES

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THIS is the second report dealing with families in which malformed children have been born. The first one concerned the place-in-family of the defective child (2).

The present communication deals with the remaining pregnancies in these families. It concerns, primarily, those which did not terminate normally, and which may be classified as "disturbed," a "disturbed" pregnancy being defined as one which ended in either a miscarriage (including abortions), a stillbirth or a premature birth. The chief interest of the study concerns the closeness of the disturbance to the defective child.

If miscarriages, stillbirths, or premature births should take place closer to the defective child pregnancy than would be expected according to the laws of chance, it would suggest that both these disturbed pregnancies and the defective child pregnancy were but different expressions of a prolonged period of decreased reproductive power. If this were so, it would seem to lend weight to the hypothesis that congenital malformations are due to defects in the germ plasma taking place before the moment of fertilization. Whereas, if the disturbed pregnancies occur at random in the family, there would be less reason to believe that the reproductive power of the mother exhibited any prolonged period of weakness. The present report attempts to elucidate this theoretical conception.

*Materials and methods.* To quote from the first communication: "There were found in the files of the Bureau of Vital Statistics, Department of Health of the State of Pennsylvania, 130,132 death certificates for still-born and live-born individuals who died in Philadelphia during the 5 year period between January 1, 1929, and December 31, 1933. Each of these certificates was examined, and the data on those noting the existence of any congenital defect, were transcribed to dupli-

cate, official forms. Fourteen hundred and seventy-six such certificates were located.

"The deceased individual was considered to have possessed a defect under either of two conditions: (1) if the defect involved the surface of the body, or (2) if internal, its presence had been disclosed by operation or necropsy. Diagnoses not conforming to these requirements were considered as not verified and were excluded from further consideration. This procedure reduced the number of usable certificates to 890, or only 60 per cent of the original 1,476 certificates.

"An attempt was made to interview the mother of each of the 890 deceased individuals, the visits being made in the summer of 1934 by 3 fourth year medical students. A complete reproductive history was secured from each mother that could be located. The group forms a consecutive series. All of the defective children died within a given geographical area and within a given period of time."

In order to have a homogeneous group of reproductive records for analysis, it was necessary to omit from consideration certain families forming the group of 539 families reported upon in the first paper. Families in the above group, having the following characteristics, were not used in the present analysis: (a) Those with more than one defective child, (b) those families in which there was only a single conception, (c) families in which the mother was married twice and in which families the defective child was born to the second husband. This procedure reduced the number of families from 539 to 405.

## RESULTS

*Diagnosis of defective child.* In the 405 families, there were 405 congenitally malformed children (Table I, column 2). The most frequently recurring chief diagnoses (column 1)

TABLE I—DIAGNOSIS OF CONGENITALLY MALFORMED CHILD

Diagnosis	Children					
	Total		Disturbed pregnancies		Undisturbed pregnancies	
	Number	Percent	Number	Percent	Number	Percent
Reported (1)	(2)	(3)	(4)	(5)	(6)	(7)
	5	100	5	100	54	100
Hydrocephalus	56		9	18	57	106
Spina bifida	73	8	6	12	7	13
Anencephalus	8	9	7	14	31	57
Hydrocephalus, spina bifida	3	7.6	7	14		14.6
Pyloric stenosis	9	2		0	7	13
Heart disease	5	6		0	5	9
Monster	6		7	14	8	15
Testicular atrophy		4	5	10	5	9
Craniorachischia	9		3	6	6	11
Hare lip, cleft palate	8		3	6	5	9
Gastrochisis	4	6	3	6	3	5
Microcephalus	6	5	3	6	5	9
Stillborn	6	6	1	2	5	9
Others	5	8	1	2	7	13

Showing in column 1 the child diagnoses that occurred most frequently in the families which form the basis of the present report in column 2 the frequency with which the anomalies were observed in columns 3 and 4 the relative frequency of the defects as they appeared in families with and without any disturbed pregnancies. Note that the essential difference in the frequency with which the different defects were observed in the two groups.

and the number of children in each group (column 2) are recorded in this table. Hydrocephalus was the most common defect, spina bifida with and without hydrocephalus and anencephalus were the next most frequent diagnoses.

In the 405 families 151 families or 37.3 per cent had one or more disturbed pregnancies (Table I, column 4) and 254 or 62.7 per cent had no disturbed pregnancies (Table I, column 6). These two groups can be compared in Table I with respect to the diagnoses of the malformed children in each. There appears to be no essential difference in regard to the types of defects found in the two groups.

In the 405 families there were 173 conceptions (Table II). Over 60 per cent terminated normally with live born fully developed offspring. Twenty-three per cent resulted in the birth of malformed infants and 13 per cent resulted in either miscarriage, stillbirth, or premature birth.

The relative positions of the various disturbances of pregnancy in relation to the

position of the conception which resulted in the birth of the congenitally malformed child are shown in Table III. The position of the defective child pregnancy is indicated by the heavy face horizontal line. The place in family of all other conceptions is shown in column 1. In this column the place immediately preceding that which ended in the birth of the defective child is indicated by -1, the conception which followed immediately that of the defective child is indicated by +1. The conception preceding, and next but one to the defective child conception is indicated by -2 and the conception following next but one to the defective child pregnancy is indicated by +2 and so on. The observed frequencies of miscarriages, stillbirths, and premature births by birth position in relation to the position of the defective child are indicated separately in columns 2, 3, and 4. Their observed combined frequencies are given in column 5. Their expected combined frequencies had they been distributed by birth position according to the laws of chance are shown in column 6.



The latter distribution was computed by the use of the Greenwood-Yule reconstruction (1). The method is as follows. The expectancy that a characteristic occurring at random will take place in any particular position depends upon the size of the family. For example, in a family of three siblings, in which there is one defective sibling, there is one-half a chance that each of the two remaining siblings will be affected, in a family of four siblings, in which one sibling is malformed, only one-third a chance exists that any one of the three remaining siblings will be affected.

Using this method, the fractions contributed to each birth position by each family were totaled by birth position for the entire group of families. In those in which there were two disturbed pregnancies, each position was allotted double the fractional value given to families with only one disturbed pregnancy. In families with three disturbed pregnancies, each birth position was given triple the birth value given to those families with only one disturbed pregnancy, and so on, depending on the number of disturbed pregnancies in the family.

Since all disturbed pregnancies in each family were counted in the total of column 5, and since in column 6, each family was counted once for each disturbance noted in column 5, the total of these two columns are necessarily approximately equal.

The ratio of the observed, combined frequencies of the disturbed pregnancies (column 5) to their expected, combined frequencies (column 6) is shown in column 7. Had the observed disturbances occurred with random frequency in the various birth positions, the figures in each birth position in column 5 would have been, for all practical purposes, identical with those in column 6. This identity would have produced a ratio in column 7 of 1.0 for each birth position.

The figures in column 7 show that the disturbed pregnancies in the position  $-1$  and  $+1$ , immediately adjacent to the defective child, occurred more often than would be expected according to the laws of chance. In the birth position immediately preceding that of the defective child the observed disturbances were the most frequent, being next most common in the position immediately following

TABLE II—MALFORMED OFFSPRING AND DISTURBED PREGNANCIES IN 405 FAMILIES

Conceptions	Conceptions	
	Number	Per cent
Total	1732	100.0
Terminating normally	1094	63.2
Ending with malformed offspring	402	23.4
Ending with miscarriage, stillbirth, or premature birth	233	13.4

Showing the number of conceptions experienced by 405 mothers, each having one malformed child, and the number of disturbed pregnancies among the remaining pregnancies. Note that more than one-third of all of the pregnancies were abnormal.

that of the defective child. In the majority of the more distant positions, the disturbances occurred less often than would be expected by chance. Three of the distant positions ( $-3$ ,  $-6$ ,  $-9$ ) showed a greater frequency than would be expected by chance. These values are believed to be false due to the fact that the number of families forming the total group was so small.

Considering the relative sizes of the observed frequencies in the  $-1$  and  $-2$  positions, column 5, it is evident that the frequency in the  $-1$  position is approximately two and a half times that of the  $-2$  position. These figures refer to the combined miscarriages, stillbirths, and premature births. If these combined disturbances of pregnancy are sub-grouped, as shown in columns 2, 3, and 4, the following is observed. The frequency of miscarriages alone (column 2) in the  $-1$  position is more than twice as great as in the  $-2$  position, the frequency of stillbirths (column 3) in the  $-1$  position is two and a half times as great as in the  $-2$  position, and the frequency of premature births (column 4) in the  $-1$  position is over three times as large as in the  $-2$  position. These individual observations lead one to conclude that the nearness of the miscarriages, the stillbirths, and the premature births to the position of the defective child were individually determined by a common cause, and by the same cause, which, in all probability, brought about the congenital malformations in the families in this group.

SURGERY GYNECOLOGY AND OBSTETRICS	
UNEXPECTED DISTURBANCES OF PREGNANCY	
Expected	
Actual	

SURGERY GYNECOLOGY AND OBSTETRICS			
TABLE III—THE OBSERVED AND EXPECTED DISTURBANCES OF PREGNANCY			Expected
	Observed	Combined miscarriage, stillbirth, birth	Combined = sum of miscarriage, stillbirth, perme and births Number

No. of families	Observed				Expected		Total
	Miscarriages	Single the	Premia are births	Combined miscarriages, stillbirths, premia are births	Combined miscarriages, stillbirths, premia are births		
					Number	Number	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
1	1	1	1	1	1	1	
2	2	2	2	2	2	2	
3	3	3	3	3	3	3	
4	4	4	4	4	4	4	
5	5	5	5	5	5	5	
6	6	6	6	6	6	6	
7	7	7	7	7	7	7	
8	8	8	8	8	8	8	
9	9	9	9	9	9	9	
10	10	10	10	10	10	10	
11	11	11	11	11	11	11	
12	12	12	12	12	12	12	
13	13	13	13	13	13	13	
14	14	14	14	14	14	14	
15	15	15	15	15	15	15	
16	16	16	16	16	16	16	
17	17	17	17	17	17	17	
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25	25	25	25	25	25	25	
26	26	26	26	26	26	26	
27	27	27	27	27	27	27	
28	28	28	28	28	28	28	
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30	30	30	30	30	30	30	
31	31	31	31	31	31	31	
32	32	32	32	32	32	32	
33	33	33	33	33	33	33	
34	34	34	34	34	34	34	
35	35	35	35	35	35	35	
36	36	36	36	36	36	36	
37	37	37	37	37	37	37	
38	38	38	38	38	38	38	
39	39	39	39	39	39	39	
40	40	40	40	40	40	40	
41	41	41	41	41	41	41	
42	42	42	42	42	42	42	
43	43	43	43	43	43	43	
44	44	44	44	44	44	44	
45	45	45	45	45	45	45	
46	46	46	46	46	46	46	
47	47	47	47	47	47	47	
48	48	48	48	48	48	48	
49	49	49	49	49	49	49	
50	50	50	50	50	50	50	
51	51	51	51	51	51	51	
52	52	52	52	52	52	52	
53	53	53	53	53	53	53	
54	54	54	54	54	54	54	
55	55	55	55	55	55	55	
56	56	56	56	56	56	56	
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63	63	63	63	63	63	63	
64	64	64	64	64	64	64	
65	65	65	65	65	65	65	
66	66	66	66	66	66	66	
67	67	67	67	67	67	67	
68	68	68	68	68	68	68	
69	69	69	69	69	69	69	
70	70	70	70	70	70	70	
71	71	71	71	71	71	71	
72	72	72	72	72	72	72	
73	73	73	73	73	73	73	
74	74	74	74	74	74	74	
75	75	75	75	75	75	75	
76	76	76	76	76	76	76	
77	77	77	77	77	77	77	
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93	93	93	93	93	93	93	
94	94	94	94	94	94	94	
95	95	95	95	95	95	95	
96	96	96	96	96	96	96	
97	97	97	97	97	97	97	
98	98	98	98	98	98	98	
99	99	99	99	99	99	99	
100	100	100	100	100	100	100	

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tion The n l n m b e r t t m u s t t e l o e o u t t e r h r t o g r e a t e r t h a t t n t h

which results in the birth of the congenitally malformed child and because all of the disturbances and the malformation vary in character and degree from the other forms of multiple twinning at due to congenital malformation at due to twinning of the fertilized egg.

RECAPITULATION

These observations suggest that twinning of the embryo is a malformation of the fertilized egg.

REF ID: A66666

The above observations suggest that mothers who give birth to congenitally malformed individuals exhibit varying length periods of decreased reproductive efficiency. In most cases this period covers only the time required for the conception and birth of a single child. In other instances the period is longer and turns this time in addition to the conception and birth of the malformed child other conceptions take place which also result in congenitally malformed individuals. In other cases the period is so long that it interferes with subsequent conceptions.

which results in the birth of the congenitally malformed child and because all of the ischaemic heart disease is due to the other character in the pair, one from the hypochondriac and the other from the hyperochondriac, it is clear that congenital malformation is due to defects in the germ plasma rather than to forces which may operate upon the fertilized egg.

The turning of the turbulence so often in the frequency immediately preceding that which results in the turbulent flow is that the appearance of a turbulent flow is not a sudden one but is a gradual one.

sible existence of a congenital malformation during the course of the succeeding pregnancy

#### SUMMARY AND CONCLUSIONS

1 The reproductive activity of 405 mothers, each having had a congenitally malformed child, is reported with respect to the incidence of miscarriages, stillbirths, and premature births

2 Of the 405 families, 151, or 37.3 per cent, exhibited one or more miscarriages, stillbirths, or premature births

3 Of the total of 1,732 conceptions in the 405 families, 63.2 per cent ended normally, 23.4 per cent resulted in malformed children, and 13.4 per cent ended in either miscarriage, stillbirth, or premature birth

4 Miscarriages, stillbirths, and premature births occurred more often than would be expected by chance in the pregnancies immediately preceding and immediately following the pregnancy which resulted in the birth of the defective child, and less often than

would be expected by chance in the remaining pregnancies Miscarriage, stillbirth, and premature birth occurred most often in the pregnancy immediately preceding that of the defective child

5 From the above observations, it is concluded that the birth of a congenitally malformed child may be only one expression of a prolonged decrease in functional reproductive activity, the other expressions being miscarriages, stillbirths and premature births

6 It is suggested that the obstetrician has unusual reason to suspect the possible existence of a congenital malformation in the pregnancy which follows immediately after a miscarriage, a stillbirth, or a premature birth

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# LOCAL ANESTHETICS PRODUCING PROLONGED ANALGESIA ELIMINATION OF PAIN AFTER RECTAL OPERATIONS

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THE most important unsolved problem in proctology today with the exception of a cure for cancer is the elimination of pain after rectal operations. This holds true because if we cannot operate on patients without causing severe postoperative pain we cannot operate on most of them at all. Most patients wish to avoid a rectal operation anyway and if there be also the knowledge that operation will be followed by hours of extreme suffering they will drag around with trouble for years rather than come for relief. Their apprehensions are not without basis. After the usual ligature operation for hemorrhoids the routine orders of Miles are given  $\frac{1}{2}$  grain of morphine shortly after operation then tincture of opium every 4 hours for 24 hours then every 6 hours for 24 hours and then every 8 hours for the third and fourth days. An article just published on postoperative care by Best states that after all is done to relieve postoperative pain the patient is likely to need morphine and codeine. Patients who have received such doses of narcotics say that they feel dizzy but still suffer.

Rectal surgery becomes thoroughly satisfactory to all when after an operation under local nerve block the patient can sit up in bed enjoy a good rest is free from pain comfortable and perfectly happy. That this can be approximated in the majority of patients will be shown.

Elimination of pain after rectal operations demands both an open type of operative technique and also the use of anesthetic solutions having a prolonged local analgesic action for 7 days after operation. The factor of operative technique will be touched upon briefly later. The main portion of this study is devoted to a new understanding of local anesthetics of prolonged action.

Of such anesthetics some have been recommended so recently that their properties have not been understood. Some are dangerously toxic. Some are likely to cause undue tissue

irritation or sloughing. Heretofore we have been left largely to guess work or to experiments on patients without accurate laboratory measurements to know beforehand just what concentration of these solutions would or would not cause tissue injury. The purpose of this paper is to present measurements of the local irritation and of the duration of local anesthesia produced by various agents.

## THE SOLUTIONS STUDIED

*Quinine and urea dihydrochloride.* A practitioner in the rural districts of Arkansas (Thibault) in using quinine by hypodermic to treat malaria discovered its prolonged local anesthetic properties and popularized its use in the double salt of quinine and urea dihydrochloride.<sup>1</sup> This salt makes a strongly acid solution and although the official name has been quinine urea hydrochloride the more accurate name is quinine urea dihydrochloride.

This preparation was abandoned by the general surgeons who found that it caused induration, edema and sometimes sloughing but it is still used by a number of excellent proctologists in rectal surgery where its irritant properties are less deleterious.<sup>2</sup> Arthur Crookall of Portland Oregon has used it in  $\frac{1}{2}$  per cent solution in 1000 cases and states that in these it never caused a slough. He does not claim that in this weak concentration it entirely eliminated postoperative pain but he does claim that it lessens the pain. Finsterer used this same  $\frac{1}{2}$  per cent concentration in

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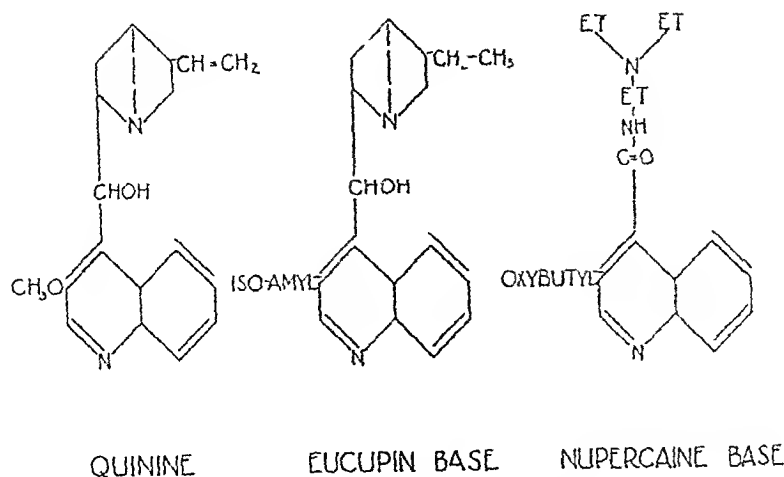


Fig 1 Eucupin, modification of quinine molecule

rectal surgery Saphir (56), of New York City, has used it in  $\frac{1}{2}$  to  $\frac{1}{4}$  per cent solution in over 2,000 hemorrhoidectomies, and at first reported that in these low concentrations, there were no sloughs. More recently he has had sloughing even in the 0.5 per cent solution in water and has abandoned it (57). In stronger concentrations, usually 5 per cent, it has been used for injection under anal fissure by W. O. Green, A. B. Graham, Yeomans, Hirschman, E. G. Martin, and others<sup>1</sup>. I shall show that it causes unnecessary pain on injection and unnecessary danger of sloughing, and that better solutions are available.

**Quinine hydrochloride with urethane.** So far as I know I am the first person to use this solution for local anesthesia. While working with it in experiments on a different problem, I discovered by accident that not only was it less painful, but also less irritating and less likely to cause a slough than quinine urea dihydrochloride<sup>2</sup>.

**Eucupin.** By modifying and lengthening two side chains of the quinine molecule, the anesthetic potency to the rabbit's cornea may be raised 3,000 per cent. eucupin (isoamylhydrocupreine) is one of these modifications.

<sup>1</sup> Martin now uses the quinine urea hydrochloride under anal fissure in 3 per cent after experiencing sloughing with the 5 per cent (57).

<sup>2</sup> This solution was first injected subcutaneously in the treatment of malaria. Pain was found to be less after its injection than after the injection of other quinine solutions (16). Later, because of its solubility, it was introduced by Genevieve in a highly concentrated solution for the injection treatment of varicose veins. The supersaturated solution in water used for varicose veins must not be used for anesthesia.

(Fig. 1) It was first synthesized as a bactericidal substance and found to be bactericidal to streptococcus in 1:4000 and to staphylococcus in 1:800 (45) (bacteriostatic to staphylococcus in 1:160,000). While using it in the eye, Morgenroth discovered its high potency as a local anesthetic. Its prolonged action is explained by the fact that it remains in the tissues locally and may be recovered for analysis 4 days after it is injected (3).

Henius, in Germany, has used it in a 2 to 5 per cent ointment or suppository for relieving the pain of anal fissure. It has also been applied in  $\frac{1}{3}$  to 2 per cent aqueous solution to ulcerating carcinoma both for its anesthetic action and also to clean up secondary infection.

**Vuzin** (iso-octylhydrocupreine) belongs to the same hydrocupreine series as eucupin but has a longer side chain. Lipschitz and Freund (34) found that it inhibited cell oxidation only half as much as eucupin and this suggested the likelihood that it might cause less local irritation than eucupin. The hemolysis tests of Bijlsma and of Schmidt also suggested that it might be less irritating than eucupin. Fromherz found that it effected a more prolonged anesthesia of the sciatic nerve of the frog than eucupin. It was therefore included in the studies to follow.

**Nupercaine** is something like a hybrid of quinine and procaine containing as it does the

TABLE I—MINIMAL LETHAL DOSES PER KILO  
GRAM BODY WEIGHT IN THE RABBIT AND  
COMPARATIVE AMOUNTS OF CLINICAL SOLU-  
TIONS WHICH WOULD THEREFORE BE EX-  
PECTED TO BE LETHAL TO A 70 KILOGRAM  
MAN

Effect	Initial rate of diss	5% L.D. g m 1 g m	5 beuta equal— Am t pced leth 5 to 3 klog m man	1% L.D. g m 1 klog m	1 tr e— Am t sol to pected le had to klog m m cm
P oca HCl %		35 (37)	4 000	20 (38)	6
P oca HCl %		(3)		5 (4)	84
N perca / %		5 (34)	5	(40)	
G HCl % han %				4 ( )	3 6
D han %		00 ( )	8	5 (4)	
Nue di HCl				5 (3)	
E per base / %		35 th 5 ( )	5	5 (8)	84

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quinoline ring of quinine and the diethylaminoethanol radical found in many of the procaine series (a butylprocainic acid diethylaminoethylene diamide hydrochloride). It was synthesized by Karl Mecher and studied by Uhlmann Lipschitz and Laubender (33) and others. Though it has been often described it is so little understood that its abuse rarely its legitimate use has resulted in frequent deaths. So this point we shall return later. The fact that in spite of these accidents its use is apparently increasing proves the urgent need for local anesthetics with a prolonged action.

**Diethane** has 2 substituted phenyl urethane radicals contained in a total molecule which is otherwise suggestive of the procaine series. It has been synthesized by Rider and suggested for prolonged local anesthesia (50, 51).

**Benacol** is a solution of equal parts of paramino benzoyl benzoate and phenmethylole in 90 parts of rectified sweet almond oil. It has been used extensively by Yeomans and his associates in the treatment of intractable pruritis ani. In England it is used at St. Mark's Hospital by Gabriel for pruritis ani and anal fissure. H. T. Hayes in Houston

has used it also at the close of hemorrhoidectomies injecting small amounts under the operative wound to give prolonged local anesthesia.

*Inucaine* is a new preparation in oil resembling benacof but having in addition one part of butylamino benzoate and  $\frac{1}{8}$  part of novocain base.

*Procaine hydrochloride* concentrate in a solution of 5 per cent has been mentioned by Schmidt as giving a longer anesthesia than nupercaine 1:1000 when both are used with adrenalin. As such a strong solution of procaine is less toxic than the weak solution of nupercaine it was included in the determination which follows.<sup>1</sup>

*Tulocaine hydrochloride* is a member of the procaine series which is about twice as potent as procaine hydrochloride and only half as toxic on subcutaneous administration to animals. Instead of the ordinary  $\frac{1}{4}$  to  $\frac{1}{2}$  per cent solution it was tried for prolonged anesthesia in a concentrated solution of  $\frac{2}{3}$  per cent.

Before comparing the local irritation caused by these solutions it is well to have in mind their general toxicity.

### COMPARATIVE TOXICITY

The comparative toxicity of these solutions must be considered from the standpoint of exact measurements in animals and then also from clinical experience.

**Animal experimentation** Measurements of toxicity in animals are shown in Table I. In this table there is included for comparison the well known anesthetics of short duration procaine and tuteocaine. The first column lists the solutions in concentrations effective for anaesthesia. The second column shows the amount of clinically effective solutions which would be lethal subcutaneously to a 70 kilo gram man if he were equally sensitive to the solutions as the rabbit. In the fourth column is shown the minimal lethal dose intravenously in the rabbit. In the fifth column is

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TABLE II.—PROTECTION BY NEUTRALITY (ACID BASE), ISOTONICITY, AND URETHANE AGAINST LOCAL IRRITATION BY QUININE SALTS—0.15 CUBIC CENTIMETER INTRADERMAL WHEELS IN RABBITS' FLANKS

	Results*	Per cent sloughs
1 a Quinine HCl 1% in quinine urea diHCl 1% in water	oooooooo	
1 b Quinine HCl 1% in quinine urea diHCl 0.7% in water	oSooooooooo	
2 a Quinine HCl 0.7% in quinine urea diHCl 1% in water	SoeooooeSo	
2 b Quinine HCl 0.7% in quinine urea diHCl 1% in 4.25% saline	oooooooo	
3 Quinine HCl 1% in 4.25% saline	SSSSSSSoS	88
4 Quinine HCl 1% with urea 0.17% in quinine urea diHCl 1.4%	eSSSSSoSo ooSSSeSoSSoSoSo	46
5 Quinine HCl 1% with urea 0.5% nearly neutral in 12.5% to 0.85% saline	Soeooooe SoeSoeoeoe	17
6 Quinine HCl 1% with urethane 0.5% fresh mixture (nearly neutral) in 4.5% to 0.85% saline	oSeoooooooo oooSeoeoe	12
7 Quinine HCl 1% with urethane 0.25% fresh mixture—adrenalin 1:1000 5 c.cm. in 0.85% saline 100 c.cm.	SeSeoe	
8 Quinine HCl 1% with urethane 0.5% old mixture (nearly neutral) in 0.85% saline	ooooooooooooe	0
9 Quinine HCl 1% with urethane 0.5% old mixture (nearly neutral) in 0.85% saline, with adrenalin	oeoeoeoeoe oooooe	0

\*S, Sloughs

e Erythema,

o, No sloughs

shown the amount of clinically effective solution given intravenously which would be lethal to a 70 kilogram man if he were equally sensitive to the solution as the rabbit

No previous record of the minimal lethal dose of eucupin administered subcutaneously to the rabbit has been located in the literature. Accordingly, 0.150 per kilogram body weight of eucupin base or 0.170 per kilogram body weight of eucupin dihydrochloride was injected subcutaneously into 8 rabbits and they were kept alive for 14 days. None of these died or showed the slightest toxic symptoms. Two rabbits were given 0.300 kilogram per body weight of eucupin base subcutaneously. One lived and one died within half an hour. The minimal lethal dose to the rabbit must, therefore, be over 0.150 per kilogram body weight subcutaneously. Bijlsma gave 0.025 per kilogram body weight subcutaneously to one kitten and the kitten died on the sixth day. I have given 4 times this dose to 2 kittens without the slightest toxic symptoms for 6 days.

It will be seen from Table I that when solutions of equal anesthetic potency are injected into the rabbit, eucupin solutions may be used safely in the largest amounts and nupercaine in the smallest amounts. In these concentrations, more than twice as much eucupin solu-

tion may be injected into the rabbit subcutaneously as procaine hydrochloride and thirty times as much solution of eucupin base as nupercaine solution of equal anesthetic power. Indeed, if man were equally susceptible to eucupin as is the rabbit, and water intoxication be disregarded, the amount of clinically effective anesthetic solution required to be lethal by subcutaneous infiltration would be about 3 gallons!

Although the toxicity of solutions administered subcutaneously varies in different animals including man, the intravenous lethal dose per kilogram body weight does not have such wide variations, and, therefore, the comparison of intravenous toxicity is shown (Table III). Here again the superiority of eucupin in freedom from toxicity is shown as well as the limitations of nupercaine.

*Clinical estimate.* From the clinical standpoint, we find that quinine hydrochloride urethane in a highly concentrated solution has been injected into man intravenously in varicose veins several hundred thousand times with only one reported fatality from toxicity (Matas).

The possibility of peculiar individual susceptibility to eucupin has been investigated by Dawson and Garside, who found that because of the long and branched side chain in

its molecule natural idiosyncrasy to eucupin is unlikely (8) although idiosyncrasy may be acquired (7).

Twenty four deaths from nupercaine have been reported (see appendix). When it is used we should be on our guard against its toxicity using these precautions. First large doses of barbiturates should be given before operation as this probably gives protection against its toxicity (63 64 69). Second in view of the considerable number of deaths known to be due to injection of solutions made by mistake 10 times too strong in 1 per cent instead of  $\frac{1}{10}$  per cent it is safer not to resort to the local pharmacist to make up the solution but to use the large 25 cubic centimeter ampules of 1:1000 solution recently made available by the manufacturers. Third in view of its extraordinary toxicity if injected into a vein or venous sinus the technique of local infiltration must be perfect in order to prevent such an eventuality especially when in hemorrhoidectomy injection is made near a ligated blood vessel. Fourth in view of a fatality with only 90 cubic centimeters 1:1000 solution injection of concentrations greater than 1:1000 or in amounts greater than 50 cubic centimeters should be made with caution.

#### LOCAL IRRITATION

There is a need for a new method for measuring tissue irritation caused by local anesthetics which I shall submit. Older methods have had partial values.

Anesthetic solutions for a long time have been injected into rabbits' ear lobes where the skin on the outer side of the lobe comes close to the skin on the inner side of the lobe to see if they would cause sloughing. Experience in this method (32) has shown that it is not sufficiently delicate for a test of local anesthetics. For example it has been found that small amounts of  $2\frac{1}{2}$  per cent quinine urea dihydrochloride do not make sloughs by this test and even 5 per cent of the same solution does not always do so but there is abundant clinical evidence to show that a  $2\frac{1}{2}$  per cent solution of quinine and urea dihydrochloride may cause sloughing.

Another test installs the anesthetic solution into the conjunctival sac of the rabbit to see

if conjunctivitis follows. This method lacks a sharp endpoint. It measures the effect on topical application to a peculiarly developed structure rather than the effect of infiltration. It allows only 2 tests on each animal whereas the test which is to be submitted allows 8 or more tests to be made on each animal and measures the direct effect of infiltration.

A third test measures the hemolytic action of the solution to be tested on red blood corpuscles. This test while not new has recently been explored thoroughly by Schmidt and has considerable value. However it has certain handicaps. It assumes that a non nucleated red blood corpuscle will respond to possible irritation by local anesthetics as do the nucleated cells of the tissue. Imagine here the bizarre results which must be expected if a hemolysis test were made on such a solution as quinine urethane inasmuch as we know that urethane acts to take quinine promptly out of serum to fix it in the red blood corpuscles (40). It does not take into account the vasoconstrictor or vasodilator effect of the solution to be tested on the local circulation. It does not allow measurement of the effect on irritation of such added substances as adrenalin and urethane which we shall show to be important. In practice it does not check with infiltration tests. For example Bijlsma found that vuzin dihydrochloride had only half the hemolytic effect of eucupin dihydrochloride on erythrocytes suspended in Ringer's solution and that even when serum was added the effect was about equal (3). Yet the experiments which I shall report indicate that vuzin dihydrochloride when infiltrated is more irritating than eucupin dihydrochloride. This may be explained by the fact that eucupin is a vasodilator and vuzin a vasoconstrictor<sup>1</sup> (Bijlsma). Hemolysis tests do not take into account such action.

The method to be submitted uses intradermal wheals made in the flanks of rabbits. If this method has not been used before it is probably because of the difficulty in removing the hair. Shaving the rabbit's hair plucking it or using a depilatory must be avoided since all such procedures cause so much irritation as to interfere with measurements of

<sup>1</sup> However Odermatt, f. d. s. m. a. b. c. tracto ac. jo. eucupin.



the irritation due to the solution injected. A high speed electrical veterinarian's clippers, on the stretched skin, aided by frequent brushing of the hair from its teeth, will remove the hair close to the skin without irritating it. Two or three such patches are made in each flank between the ventral and dorsal areas. Care must be taken to keep away from the gluteus maximus and biceps femoris muscles, as sloughing is more likely to occur in this region. If the patches are too close to the artery located over the shoulder, sloughs which would occur elsewhere would not be observed. If the hair which remains interferes with the observations, it should be wetted. Two injections of 0.15 cubic centimeter each are made into each one of the two patches, making 8 in all. In case uniform results are not obtained, a much larger number of injections may be made.

These intradermal injections make a delicate test because the solution lies under the horny epidermal cells with poor blood supply and, therefore, a slough is more apt to occur by this method than in ordinary tissue infiltration. Comparison with the wheals that have been produced in the skin of the human thigh indicates that rabbit skin is more sensitive. The delicacy of this test can be still further increased by the addition of adrenalin to the solution.

In the protocol which follows, it will be noted just what concentrations of nupercaine, eucupin solutions, quinine urea dihydrochloride, quinine hydrochloride and urethane, diethane, and benacol and anucaine can be injected in amounts of 0.15 cubic centimeter intradermally in the rabbit with and without sloughing. These tests have been made with aqueous and isotonic solutions, with and without adrenalin. An "S" is marked where a slough occurred, an "o" where there was no change, and an "e" where there was erythema without sloughing. I made more than 1,300 of these wheals in rabbits and give reports where the findings proved of practical significance.

*The optimum solution for quinine.* It will be seen from Table II that the highest concentration of quinine and urea dihydrochloride in water which can be used without sloughing

is  $\frac{1}{2}$  per cent quinine and urea (containing  $\frac{1}{3}$  per cent quinine hydrochloride). This is important because it shows that this laboratory method agrees in results with clinical experience in the thousands of cases reported by Crookill, Finsterer, and Saphir.

Quinine hydrochloride in 1 per cent solution in saline gave sloughs in nearly every wheal (88 per cent sloughs). When the same concentration of quinine hydrochloride 1 per cent was used in ordinary quinine urea dihydrochloride 1.4 per cent, less than half (46 per cent sloughs) of the wheals sloughed. This shows that the addition of urea does prevent some of the irritation of quinine, as is generally accepted. But a very much greater improvement came when (a) the amount of urea was increased to 0.5 per cent, (b) no hydrochloric acid was added, and (c) 0.425 per cent saline was used instead of water (17 per cent sloughs).

Still greater was the improvement when urethane was substituted for urea. A fresh solution of quinine urethane caused only 12 per cent sloughs. A well aged solution of quinine hydrochloride and urethane kept for 3 weeks showed no sloughs at all. Even when adrenalin was added (and we shall see later that the addition of adrenalin increases greatly the tendency of most solutions to slough), a well aged solution of quinine urethane was used in 18 wheals without a slough. One may conclude that about three times as strong a concentration of quinine hydrochloride can be used in a well aged solution with 0.5 per cent urethane, even with adrenalin added, without sloughing, as can be used when made up with urea and hydrochloric acid in water in the ordinary quinine and urea dihydrochloride. This is the first advantage of quinine urethane solution over quinine and urea dihydrochloride.

A second advantage is that quinine urethane keeps better than weak solutions of quinine and urea dihydrochloride, which tend to deteriorate because, as Gemsa found (16) the urea decomposes to form alkaline ammonium which precipitates the alkaloid quinine, and this process probably is accelerated when the quinine and urea are in a less acid solution. This may be the reason, certainly

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a good one why quinine and urea have been used in an acid solution But when urethane is added this trouble is avoided for it has been known for a long time (16)—and I have confirmed this—that quinine with urethane if not saturated does not precipitate on standing

There is a third reason for the superiority of quinine hydrochloride with urethane over quinine urea dihydrochloride quinine and urea dihydrochloride causes an immediate violent pain at the site of injection Quinine urethane causes little if any such pain as any one may verify

Fourth intracutaneous wheals were made by injecting urea dihydrochloride and quinine hydrochloride urethane The first showed a wide border of erythema around them The quinine hydrochloride urethane did not This indicates that quinine urethane is less irritating

One may conclude that a well aged solution of quinine hydrochloride urethane with sodium chloride added to isotonicity and adrenalin is superior to the classic solution of quinine and urea dihydrochloride

*Protective action of urethane* It has been known to Frohlich to Winkler and to Danzen Peng that the systemic administration of urethane in large doses inhibited the irritant action of mustard oil on the skin but no previous reference has been found to the fact that infiltrated locally small concentrations of urethane added to quinine have a protective action against irritation and sloughing

The change which urethane makes is not that it merely prevents inflammation but that it prevents inflammation might actually less on the resistance of the tissue to injury But my experiments show that it actually prevents tissue injury and sloughing

The action does not seem to be on the pain nerves for while urethane 5 per cent is anesthetic concentrations below 2 1/2 per cent are not (23) It does not seem to protect by action bringing in a better supply of blood and serum to the site of injection because there is less redness around a wheal into which quinine urethane is injected than when wheals are made with quinine urea dihydrochloride or nupercaine

That urethane like urea has a lytic action on the fibrin (42) laid down by quinine and thus prevents irritation is one possibility Another is that the protective action of urethane is exerted not on the tissues but chemically on the quinine It has been noted that when urethane is added to quinine there is a change in the lines of the absorption spectrum (19) This has been ascribed by Thron (10) to the formation of quinin or quinoxin an isomere of quinine which Sollmann (61) showed was contrary to its name not exceedingly toxic However the quinoxin occurs only in 3 per cent in de Thron's findings and one therefore question whether this can explain the protection conferred by urethane against tissue injury It might seem more probable that the urethane combines with the quinine probably at the unsaturated double bond in the vinyl side chain In this connection it may be noticed that nupercaine the least irritating of the quinolin anesthetics also has a structure suggestive of a substituted urethane

The fact that aging of the solution of quinine urethane makes it less irritating may be explained on two grounds Either time and sunlight allow the urethane to become more thoroughly united with the quinine molecule or else the quinine turns to quinoxin (quinoxin) This problem is now being studied

*Effect of osmotic pressure* It will be seen from a study of the controls in Table IV that 3 wheals made with distilled water out of 12 caused small sloughs whereas none of the 12 made with physiological saline made sloughs This shows the importance of isotonicity even without the addition of adrenalin

A further study of the controls shows that procaine hydrochloride and tutocaine hydrochloride can be used in aqueous solutions with adrenalin without sloughing This however does not hold at all for the other solutions

In the case of nupercaine although the manufacturers rightly advise its use in saline the importance of this is not generally realized I have found one of our ablest surgeons using

It has shown that the erythrocytes are not lysed out of the blood serum by the action of the drug in 1 minute from the kidney.

It has been shown that urethane does not cause leukocytosis

TABLE III—TISSUE IRRITATION BY LOCAL ANESTHETICS, 0.15 CUBIC CENTIMETER INTRACUTANEOUSLY IN RABBITS' FLANKS

Solution	In water	Approximately isotonic	In water with adrenalin	Approximate isotonic with adrenalin†
Distilled water or saline	ooooSSoo	oooooooooo	oSoeoooo	oooooooo
Procaine HCl 1%			oooooooo oooooooo	
Tutocaine HCl 1%			oooooooo	
Procaine HCl 5%			oooooooo	
Nupercaine 4/10%		ooooSeeee		
Nupercaine 3/10%		oooooooo		ooooooSS
Nupercaine 2/10%			eSSoSSSS	oooooooo
Nupercaine 1/10%	oooooooo		SeeeeSSS	oooooooo
Eucupin base 1/10% HCl 10% 2 c cm in 100 c cm	Tutocaine 1/2% oooSSSSoooo	oooooooooooo	oSoeSSSSo	oooSeSSoooooo
Same with urethane 1/5%				oooooooooSo SeSeooooS
Eucupin base 1/10% HCl and NaOH to dissolve procaine HCl 1%	SooooSoSo	oooooooooooo†		
Vuzin base 1/10% in Vuzin diHCl 11/100% 10% HCl 5 c cm to 100 c cm				SSooSeoSS
Eucupinotoin in 2/10%				SSooSSSe
Diothane 1%	SSSSSSSSo	oeSSSSo		
Diothane 1/2%		oSoooooo ooooooooooooSSoo SSooSSeeoo		
Diothane 1/5%	ooSeSoSo			
Benacol (oil)	SSSSSSSS			
Anucaine	SSeSSSSS			
Nupercaine in oil	SSSSSSSSSSSSSS SSSSSS			

\*In some early experiments where erythema occurred without sloughing a zero was recorded.

†Adrenalin was used 0.5 c cm of 1:1000 solution in 100 c cm

‡No procaine hydrochloride added

nupercaine in an aqueous solution. The experiments in Table III show that nupercaine 1:1000 in water with adrenalin is likely to cause sloughing. Twice as great a concentration can be used with adrenalin in saline without sloughing.

Again in the case of eucupin, tests show (Table III) the importance of isotonic rather than aqueous solutions, illuminating one of the mysteries of medical history. De Takats of Northwestern University, performed over a hundred operations with eucupin in saline without a single slough. One hundred intradermal wheals which he made caused no sloughs. Then other workers (44) used it in

solutions which were 'water solutions in the majority of cases' and had sloughs. As a result of their condemnation, the surgical world did nothing further with eucupin. How did it happen? The protocols in Table III show that both sides were right in their experiments. Twenty-one wheals made with eucupin hydrochloride in saline caused no sloughs. Twenty wheals made with eucupin hydrochloride in distilled water did show frequent sloughs.<sup>1</sup>

Clinicians sometimes assume that, because sodium chloride 0.85 per cent is isotonic with

<sup>1</sup>I must warn against the solution tried by Peard which is made in water in 0.1 per cent and is likely to cause sloughing.

TABLE IV—EXPERIMENTS TO MODIFY TISSUE IRRITATION BY EUCUPIN  
0.15 CUBIC CENTIMETER INTRACUTANEOUSLY IN RABBITS FLANKS  
All solutions proportionately isotonic

Effect of pH	Wound drainage	Adrenaline solution
Eucupin base Eucupin hydrochloride pH 5	00555000	
Eucupin base Eucupin hydrochloride pH 5	00000000	
Eucupin base Eucupin hydrochloride pH 6		See 555
Eucupin base Eucupin hydrochloride pH 6		550 5550
Hydrocortisone Erythromycin		



Fig. 2. Site for incision and healing of the flank.

body fluids procaine hydrochloride is isotonic in the same concentrations. This is a wrong assumption. Procaine hydrochloride is not isotonic in 1 per cent but in 5.48 per cent (4) Eucupin in a 1 per cent procaine solution or a half per cent tutocaine solution is far from being isotonic.

**Effect of adrenalin.** The results of experiments with the addition of adrenalin shown in Table III were an unpleasant surprise. The addition of adrenalin is necessary for the prolongation of analgesia for several days. Yet these experiments show that in all these solutions tested except procaine and tutocaine the addition of adrenalin greatly increased the tendency to tissue injury. This was unfortunately true to a marked degree with eucupin.

**Effect of acidity on eucupin.** Table IV shows the desirability of keeping anesthetic solutions such as eucupin away from the acid side. This agrees exactly with tests on the conjunctival sac made by Sollmann (60) by Copeland (5) and by Gifford (18) showing less irritation if solutions are kept nearly neutral. However a solution buffered in borax boric acid made on the suggestion of Gifford's work was not free from sloughing tendency when adrenalin was added.

It is shown by the tests to be more irritating than eucupin.

**Diothane.** I have no judgment to pass on diothane for topical application but the tests made for infiltration in Table III show that in aqueous solution the form in which it is recommended it has a pronounced sloughing tendency. The addition of saline partly helped

this but caused an early precipitation of the diothane.

**Benacol** had a destructive action. Sloughs were large and deep. It would seem to be painful for even the long suffering rabbit who did not squirm upon the injection of any other solution except distilled water jumped and squirmed or actually cried out in loud squeals when wheals were made with benacol. It may be desirable for the destruction of subcutaneous nerves in pruritis and but one feels reluctant to class it as a local anesthetic. **Anucaine** was equally destructive causing sloughs in nearly every wheel. So also did nupercaine in oil.

Although an anesthetic solution for the purposes of rectal surgery to be described must not cause too much irritation it is not necessary that such a solution have the perfect freedom from irritation which is a sine qua non of general surgery.

First in general surgery there must be prompt union of the tissue layers and such union must not be delayed. In rectal surgery many of us prefer to leave wounds wide open to be healed by second intention. Second it is known that solutions which might cause sloughing if injected in an area where the tissues are under pressure will not cause sloughing if there be no pressure or tension. In closed surgery with the wound sewed up

tight, there is postoperative tissue edema and sometimes pressure. This is avoided in open types of rectal surgery. Third, in rectal surgery a cause of delayed healing is the spasm of the sphincter muscle after operation, which grips the operative wound so tight as to cause ischemia. Prolonged local anesthesia prevents this vise-like grip of the sphincter, prevents the ischemia and thus facilitates healing. Fourth, in rectal surgery in the lower area in the skin below the mucocutaneous line, delayed healing may be actually desired when fissures and infected crypts need prolonged surgical drainage.

On the other hand one has reason to protest against the common use, even in rectal surgery, of some of these irritant, if not destructive, solutions. There is especial danger of postoperative hemorrhage when such solutions are injected into the anal canal near the large branches of the inferior hemorrhoidal artery.

#### COMPARATIVE ANESTHETIC POWERS

Of the large number of methods previously devised to measure the anesthetic power of solutions, two are of outstanding importance. First, the intracutaneous wheal to measure the potency of anesthetics for infiltration, and second, instillation into the rabbit's conjunctival sac to determine whether or not the solution paralyzes the corneal reflex. It will be shown later that deduction from the rabbit's cornea test, if applied to oily solutions, may lead to errors, and a new test will be presented to measure the power of local anesthetics on topical application, utilizing directly the open wound.

In using tests on the intracutaneous wheal, I have sought to avoid errors made in the past. How unsatisfactory past methods have been is shown by the wide divergence in results. For example, in measuring the duration of anesthesia in the wheal made by procaine hydrochloride, pharmacologists of high standing report results in the wheal made by procaine hydrochloride varying from 9 minutes to 35 minutes, and in the wheal made by nupercaine, a duration varying from 35 to 100 minutes (28). Exactly the same amount of anesthetic must be injected into the wheal or



Fig 3 Testing of surface anesthesia with Harvard inductorium

wide variations in the duration of anesthesia will result. I have used 0.4 cubic centimeter because this gives a large enough wheal to avoid doubtful readings. Still more important is the choice of an instrument to test anesthesia in the wheal. The wisp of cotton, the pin prick, and the blunt wire all cause error, because the tip may contact a point in the skin between nerve endings. An associate tested the skin of my forearm with the twisted wisp of cotton and found that in 3 places of 15 so tested without any previous injections of anesthetics the wisp of cotton could not be felt. A stroke with a pin, or the use of an electric current between two terminal wires covers enough space to catch a nerve ending, which may be missed by contact at a point. The pin scratch method has the advantage of avoiding the irritation caused by the electric current. On the other hand, the electric current has the advantages of giving a clearer endpoint and of measuring pain sensation without admixture of touch and pressure sensation. In these experiments electrical stimulation was used between the ends of 2 fine wires conveyed from an inductorium.

The first column in Table V shows the duration of anesthesia when adrenalin was not added to the solutions. The solution of quinine urethane gave a much longer anesthesia than the solution of quinine urea dihydrochloride. Nupercaine gave anesthesia of shorter duration than eucupin.

The second column shows that when adrenalin was added, nupercaine gave a more prolonged anesthesia than eucupin with tutocaine and adrenalin.<sup>1</sup> Nupercaine with tutocaine

<sup>1</sup> De Takats, in wheals on the forearm, obtained anesthesia for 7 hours from the eucupin tutocaine adrenalin solution. My results show a much shorter duration but my tests with electrical stimulation give a much stronger stimulation than the skin scratch which he used.



per cent to  $\frac{9}{10}$  per cent in water always produced partial anesthesia and usually complete anesthesia. Eucupin  $\frac{1}{2}$  per cent in physiological saline solution was not so effective as the eucupin in water.<sup>1</sup>

Nupercaine 1 per cent solution was not tested against the 1 per cent nupercaine base in ointment because strong solutions of nupercaine are too toxic to be used in large amounts.

Someone may inquire, "But does not an oily solution act better because it stays there longer slowly feeding out the anesthetic?"

This might be true of an anesthetic of short action, but we are now dealing with anesthetics which after absorption in the tissues give a prolonged action. As a matter of fact, these anesthetics are so extremely soluble in oily bases as compared with the tissues that they are not absorbed well from their nest in the oily base. Possibly the reason why they do anesthetize the cornea and not the open rectal wound may be found in the fact that the cornea has neither blood vessels nor lymphatics which would carry away the absorbed drug. Moreover, the nerve fibers in the cornea are non-medullated.

#### CLINICAL FINDINGS

From the laboratory findings presented, one should expect quinine urethane solution to be far superior to all other known local anesthetics of prolonged action, because, when such solutions, in the highest concentrations which can be used without sloughing are compared, quinine urethane solution gives by far the longest anesthesia. Clinical experience, however, raised an unexpected difficulty when quinine urethane solution was used for infiltration in operative surgery: it prolongs the bleeding time so that the wound may ooze for 2 or 3 days. For this reason it was abandoned in operative surgery.

On the other hand quinine urethane has justified expectations for the purpose of injection of anal fissure. It can be used in a higher concentration without sloughing than can quinine urea dihydrochloride, it is more stable and, most important, it does not cause such severe pain on injection as quinine

<sup>1</sup> Similarly Hertzler found that in aqueous solution the absorption of procaine hydrochloride by the pentoneum was more rapid than when the procaine was dissolved in physiological saline.

TABLE V—COMPARATIVE DURATION OF ANESTHESIA—INTRACUTANEOUS WHEELS, 0.4 CUBIC CENTIMETER ON ABDOMEN—3 WHEELS WITH ADRENALIN—4 WHEELS WITHOUT ADRENALIN—TEST WITH HARVARD INDUCTORIUM

Solutions	Without adrenalín	With adrenalín*
1 Physiological saline (control)	No anesthesia	
2 Distilled water	Less than 35 min	
3 Quinine urea dihydrochloride in water 0.5%	1 hour 20 min	
4 Quinine urea dihydrochloride 0.5% in saline	Less than 45 min	
5 Quinine hydrochloride 1% Urethane 1.5% in physiological saline	Complete 1 hr 30 min Partial 5 hours	Complete 5 hours Partial 3 days
6 Nupercaine 1/10% in saline	1 hour	Between 2 and 3 hours
7 Nupercaine 1/10% in saline with tutocaine 0.5%		3 hours 15 min
8 Eucupin base 0.1% Hydrochloric acid 0.2% Tutocaine 0.5% in saline	Complete 1 hr 30 min Partial 2 hours	Between 1½ and 2 hours† Partial 3 hours
9 Procaine HC 0.5% in water		3 hours 10 min
10 Tutocaine HC 2.5% in 0.425 saline		4 hours 10 min
11 Eucupin base 1% in rectified sweet almond oil (one wheel only)	No anesthesia—redness and pain	

\*Adrenalín 1:1000 was added 0.5 c cm. to each 100 c cm. of solution.  
†When adrenalín 0.1 c cm. was added instead of 0.5 c cm., the duration of anesthesia was unchanged.

urea dihydrochloride. Of course any anesthetic solution, even procaine hydrochloride, will cause pain if injected under some hypersensitive fissures, but quinine urethane solution is much less likely to cause pain than quinine urea dihydrochloride. It is now being used in a concentration of quinine hydrochloride 1 to 3 per cent, with urethane in half the concentration of the quinine. Usually 1 or 2 cubic centimeters are injected under a fissure.

Quinine urethane solution may also prove of value in the injection treatment of pruritis ani.<sup>2</sup>

It must be warned that the supersaturated solution of quinine urethane used for varicose

If quinine urethane is mixed with novocain suprarenal solution "K" which is the common form sold in ampuls a gelatinous precipitate forms. This is due to potassium sulphate added to the ampul as a stabilizing agent, which precipitates quinine. This difficulty can be avoided by using ordinary bulk procaine hydrochloride or a tablet of tutocaine.



Fig 4 Sites of wheal determined at onset of anesthesia in the absence of a local anesthetic around quinine urethane wheals.

vein injection is too strong for any of these purposes

#### EUCUPIN FOR TOPICAL APPLICATION

Three fourths per cent eucupin base with just enough 10 per cent hydrochloric acid added drop by drop to dissolve in water has proved to be of great value in postoperative wounds after fistulectomy excision of pilonidal sinuses and hemorrhoidectomy. Indeed in large fistulectomy wounds infiltration is impracticable and topical application is the only method available. Eucupin solution not nupercaine solution should be used for this purpose because nupercaine solution is too toxic to be used in the high concentrations and large amounts needed for topical applications. Eucupin is also relatively inexpensive. The same patient who has had nupercaine ointment applied with little or no relief will tell you that there is no comparison between the two methods that after the eucupin solution there is complete relief of pain some times for 12 hours or more.

Eucupin 0.75 per cent solution is also being applied topically in cases of prolapsed strangulated gangrenous hemorrhoids. Such cases are not usually operated on by competent proctologists in this stage. Eucupin applied both relieves pain and keeps down infections.

One of the chemists who prepared the 0.1 per cent solution of eucupin buffered in borax boric acid heretofore described dropped this

into his nose for the relief of hay fever. Ephedrine gave him relief for only 15 minutes. This eucupin solution made his nasal passages perfectly clear for 24 hours and nearly clear for a second 24 hours.

#### TECHNIQUE OF EUCUPIN APPLICATION

Upon topical application of eucupin 0.75 per cent solution in the open wound there is sometimes a stinging which may last 5 to 15 minutes. For this reason it should be applied before the anesthesia obtained prior to operation has worn off. Its anesthetic action will then last so long that reapplication of eucupin can be made before anesthesia from the first application has worn off. Cotton does not stick to the wound as does gauze at the time of reapplying fresh eucupin. The cotton soaked with eucupin should be pressed into the wound for 5 full minutes and then left in the wound. It may then be reapplied in the same way every 3 hours for four times. Then the eucupin soaked cotton should be taken out and left out. More prolonged use is unnecessary and may delay healing of the wound.

#### HEMORRHOIDECTOMY WITH PROLONGED LOCAL ANESTHESIA

It is not to be expected that pain after hemorrhoidectomy can be avoided when the ligature or the various closed suture operations are performed. In order to make the patient comfortable the open Pennington operation has here been followed which dissects out the whole external and internal hemorrhoid down to the sphincter fibers and out in triangles of skin and then picks up the hemorrhoidal vessels in as small a bite of the hemostat as is possible for double transfixion and ligation. The new operating speculum devised by Fansler makes comparatively easy this which is otherwise a difficult operation.

Spinal or sacral anesthesia is rarely and general anesthesia never used. Anesthesia has been obtained by blocking of the branches of the internal pudendal nerves in the ischio rectal fossa. Tutocaine has been used for this purpose because it is twice as potent and about half as toxic as procaine hydrochloride.

In the earlier cases eucupin 0.1 per cent in physiological saline with adrenalin was in



filtrated at the close of operation under the wounds. Later nupercaine 0.1 per cent solution in physiological saline with adrenalin, for infiltration was used, fortified by the topical application of eucupin 0.75 per cent solution by the technique heretofore described.

Now, all infiltration by these solutions has been abandoned and eucupin 0.75 per cent in water by topical application to the open wounds by the technique described is used alone. This is usually sufficient. The eucupin thus topically applied has a great added advantage in its powerful bactericidal action which causes it to prevent infection in this field, exposed to contamination.

*Clinical results.* Stress had been laid on controlled laboratory measurements, because clinical findings can prove the comparative value of these local anesthetics only when very large numbers of cases with very large numbers of controls are available. This is especially true in this rectal problem where patients vary so greatly in their susceptibility to pain. Clinical results given are presented, not as demonstrations, but as suggestive. After 100 rectal operations, patients were told that they could have as much narcotic as they pleased—usually morphine or codeine. Of these, 14 wanted one dose of narcotic, 13 wanted more than one dose, while 73 did not want any narcotic at all. This makes 87 per cent who were free or nearly free from serious pain for the 3 days after rectal surgery.<sup>1</sup> Of these, a few had barbiturates the night after operation to prevent restlessness and most had barbiturates before operation. Three radical operations for internal and external hemorrhoids were performed in the office under local anesthesia. To each of these patients a prescription for codeine was given. Two of the three never had the prescriptions filled as they had no need for the codeine. Another patient, seen in the hospital 7 hours after a radical hemorrhoidectomy, complained strenuously because he was kept in the hospital saying "I feel perfectly well. I want to get up and walk home!"

#### SUMMARY

1. An improved method for measuring local irritation by local anesthetics was used

in 1,300 tests. The highest concentrations which can be used without sloughing were determined for nupercaine, eucupin, quinine urethane. Similar tests were made of tuto-caine hydrochloride, procaine hydrochloride, benacol, anucaine, nupercaine in oil, diothane, and quinine urea dihydrochloride. Vuzin proved more irritating than eucupin.

2. Topically applied in the open wound by a technique described, eucupin 0.75 per cent solution gave excellent results after operations for anal fistula, pilonidal sinus and hemorrhoids. It may also be applied to prolapsed strangulated gangrenous hemorrhoids. Its bactericidal qualities in addition to its prolonged anesthetic action enhances its value in rectal wounds subjected to contamination.

3. After 100 rectal operations in which prolonged local anesthetics were used, narcotics were offered freely to all, but 73 per cent of the patients were so free from pain that they wanted no narcotic.

4. A solution of quinine urethane not in the concentration used in varicose veins proved the best of these solutions for injection treatment under anal-fissure.

#### APPENDIX

##### DEATHS FROM NUPERCAINE Toxicity of nupercaine clinical

##### Deaths from spinal injection—

Hechenbach, W. Ztschr f urol Chir, 28	295	010
Jones, W. H. Quoted by Arnheim and Mage, Lancet, 1930, 219	549	0075
Steinbrück, M. Zentralbl f Chir, 1930, 57	273	014
Arnheim and Mage (Weinstein) Surg, Gynec & Obst, 1932, 54	826, 2 c cm of 1 200	010
Keyes and McLennan. Am J Surg, 1930, 60	1	010
Idem, J. Am M. Ass., 1931, 90	2035	010
Ibid		010
Ibid		not stated

##### Deaths from intraperitoneal injection—

Mandl, F. Zentralbl f. Chir, 1930, 57	2966	
	150 c. cm of 1 1000	
Idem. Wien klin Wchnschr, 1929, 42	1393	

##### Deaths from topical application—

##### Nose—

Muenchen med Wchnschr, 1929, 76	2009	
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##### Urethra—

Tinnin, F. Samml Vergiftungsfallen, 1932, 3		
	215	10 c cm of 1 5 per cent

##### Bladder—

Keyes and McLennan. Am J Surg, 1930, 9	1	amount not stated
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##### Infiltration—

Freund. Klin Wchnschr, 1929, 8	1444	
	130 c cm of 1 1000	

- Kuehn l Uge k l f Lag r 1937 37 9 4  
 1 000  
 D l gaa d Uge k l f Lag r 03 41 006  
 200 cm f 1 000  
 Siebne Q cited by Keje nd McLenn n (loc. t)  
 Chiru g 1929 1 1 3  
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 Medico-Leg l f Am M A s 933 00 45  
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 Allg meinsprax 1930 p 43  
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 13 FROELICH Ar h f Expe Path u Ph rm k l 9  
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 14 FROMERE K Arch f e per P th u Pharm k l  
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 Ph rmacol 1923 90 2 7  
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 S e p e B l & Med 9 7 6 56  
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 9 8 44 7 9  
 46 MURGOA S D uts he Zts h f Ch 9 8 2  
 47 ODERMATT D ut che Ztschr f Ch 9 3 177 90  
 48 PENG DANZEN Ar h f p r fath u Pharm k l  
 930 6 2 0  
 49 PICARD H M e ch n m d Wchnschr 9 67  
 808  
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 59 SOLLMAN V f f h rm l & Exp r Th p 9 8  
 p 8  
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 61 Idem J Am M A s 9 70 909  
 62 STITT H L A a Ot l Rh n l & Lar g l 935  
 4 587 80  
 63 TATUM J Ph arma l & Exp Th p 93 4  
 2 6  
 64 TATUM t l f Am M A s 9 5 84 77  
 65 THIBAUT HEVRY f A l nsa M Soc 907 Sept  
 Ab tra t d o J Am M A s 907 49 7 9  
 66 UHLMANN N a l s e l th 9 9 0 69  
 67 VOGEL H M d kl 9 7 409  
 68 VON OERTINGEN Th pe t l gnt f th Quin l  
 G up p 49 Ch m cal C l l g C 933  
 69 WAZLA d A e l l oc Soc E p I l & M d  
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 70 WIEDIGT G Mue h m d W hsch 9 4  
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## A NOTE ON PRIMARY SHOCK

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THE proper evaluation of the several etiological factors commonly thought to underlie primary shock is of considerable clinical importance. The interrelation of these factors has been discussed too frequently to warrant recapitulation here. For a recent summary of the subject the reader referred to an article by Walter Cannon. It seemed that one bit of evidence might be obtained from a study of the systemic effects of local tissue damage in an animal isolated, physiologically, from the traumatized tissues.

The literature upon parabiosis, vascular parabiosis, and crossed circulation was reviewed, beginning with Paul Bert's account of his *greffe animale*. No record was found of a satisfactory application of these to the study of shock.

Vaccarezza, in a study directed toward reaching a better understanding of the effects of tissue injury of several sorts, performed the following experiments, using dogs as experimental animals and chloralose for anesthesia. In a series of experiments, the skin of one leg, from claws to "two finger breadths above the femorotibial articulation" was subjected to thermal injury. The result was physiological collapse and death within 10 hours. Then, by leaving intact the nerves to the extremity and clamping the vessels supplying and draining it, he was able to mitigate these effects. Finally, he established a vascular union between two subjects in such a fashion that blood perfusing the traumatized extremity of one animal was returned to the systemic circulation of the other. The technique was as follows: after treating the leg of one animal, A, Vaccarezza injected physiological salt solution through the femoral artery until it was returned clear via the corresponding femoral vein. An anastomosis was then carried out between this femoral artery and the carotid artery of a normal animal, B. In this way blood from the

uninjured animal B irrigated the leg of A. Since the femoral nerve was left intact, the injured extremity had nervous connection with animal A and vascular connections with the healthy animal B. In the two experiments performed, the uninjured animals died, in 5 and 8 hours, while the traumatized animal lived. It was noted that the circulatory exchange persisted only "a few hours," due to the fact that blood coagulated and occluded the anastomoses.

The evidence from these experiments contributed to the author's conclusion that "the cause of shock and death in these cases is due exclusively to the influence of toxic products which, originating at the site of trauma, are carried by blood vessels and lymphatics to the general circulation."

Several criticisms of the foregoing suggest themselves. In the first place, the experiments were not controlled. The history of crossed circulation experiments suggests that evidence thus obtained must be based upon carefully controlled conditions. The thromboses that occurred at the anastomoses in addition to terminating the experiments for all practical purposes, indicate the existence of another pathological process, in itself capable of producing death through embolism. In addition, death may follow anesthesia alone, or, as we later found, may occur from pulmonary lesions incident to the prolonged immobilization under anesthesia. Finally, the absence of necropsy reports leaves one somewhat in doubt as to the actual causes of death.

Since the findings have been quoted by other investigators in spite of these possible objections, and inasmuch as they seemed a particularly pertinent contribution, we decided to repeat and extend the work.

## EXPERIMENTAL PROCEDURE

Large animals were selected and paired for equality of weight. With one exception,

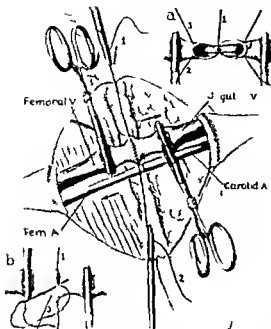


Fig. 2. a) Detail of the peritoneal procedure. b) Detail of the anastomosis. The anastomosis is performed with the method of Doerfler, Carrel, Guthrie technique. The posterior and edges are united.

the extremity of the heavier subject was used.

After preparation of the left hind leg and thigh of one animal A and the neck of the other animal B each animal was given an intravenous injection of 0.5 gram of sodium amylal in 10 per cent solution. The skin was prepared with iodine and alcohol and the adjacent skin surfaces posterior to the sites of incision were brought together with a continuous suture. Small amounts of ether were administered from this point to the completion of the operation. It should be stated definitely at this point that anesthesia was complete and effective throughout all experiments.

An incision was made to the left of the midline of the neck of animal B and through this the jugular vein and common carotid artery were exposed and liberated from surrounding tissues. These then were coated with sterile mineral oil, returned to their beds and lightly covered with gauze moistened with warm physiological salt solution.

A left inguinal incision served to expose the proximal ends of the femoral artery and vein of animal A. Branches of the artery and tributaries to the vein in this region were ligated to avoid the possibility of a vascular shunt and the vessels were freed from surrounding tissues the femoral nerve being carefully protected. The vessels were then coated with mineral oil and overlaid with moist sponges. A continuous silk suture was employed to bring together the posterior portions of both wounds.

The leg of animal A was then treated from the claws to points 4 centimeters above the femotibial articulation anteriorly and 6 centimeters above this articulation posteriorly the Vaccarezza technique being used. Next the femoral artery and vein of animal A were divided high in the groin between clamps. By means of a bulb syringe with a drawn out and rounded tip the vascular bed of the extremity was washed out rapidly with warm salt solution the injection being made under moderate pressure into the artery and continuing until only bloodtinged solution came from the free end of the vein. These vessels were caught gently in rubber-shod clamps lubricated and protected by moistened gauze while the carotid and jugular vessels of animal B were divided high in the neck.

The anastomoses were then carried out the carotid artery of animal B being united with the femoral artery of animal A and the femoral vein of animal A with the jugular vein of animal B so that blood leaving the systemic circulation of animal B traversed the vascular channels of the leg of animal A and returned to its original source.

The operative procedure and the method used in the anastomoses are illustrated in Figure 2. The unions were accomplished by the familiar Doerfler Carrel Guthrie technique in which after the placing of three guy sutures (Figure 2a) a continuous suture of fine lubricated silk piercing all coats is employed to bring the edges into end-on approximation (Figure 2b). The drawing also shows the anastomoses running in front of the suture line uniting the posterior portions of the two incisions. Upon completion of the anastomoses this suture was continued

TABLE I

Maneuver	11	Controls	12	13	Experiments	14
Weight of A	2.1 k	2.1 k	2.2 k	2.2 k	2.6 k	
Weight of B	2.5 k	1.4 k	2.7 k	2.7 k	2.7 k	
Anesthetic	50	50	50	50	50	
Operational	40	15	100	100	100	
Table 12	None	None	00	00	15	
Arterial pressure	2.15	1.0	1.5	1.5	1.10	
Division	1.10	1.05	1.05	1.05	1.05	
Fate of A	Recovered	Recovered	Killed	Killed	Killed	
Fate of B	Recovered	Recovered	Recovered	Recovered	Recovered	

The salient data of the two experiments on thermal trauma (Nos. 13 and 14) and the two control procedures (Nos. 11 and 12). Time intervals are given in minutes and hours; the experiments being presumed to begin with the administration of the anesthetic.

in such a fashion as to unite the skin edges of the two wounds entirely around the vessels—a tube effect.

With the completion of the operation ether was discontinued, animal B was rolled toward animal A and the two turned completely over. This, as will be seen, was found an important part of the technique. Care was taken to support the head of animal B in such a manner that there could be no interference with the circulation of the leg of animal A. Other precautions were taken to this same end. In all experiments, this leg remained warm, and phenolsulphonphthalein, injected intramuscularly into animal A, was found in quantity in the urine of animal B.

It was planned to terminate the experiments after 8 hours, this period equaling the longest survival of animal B in Vaccarezza's experiments. However, the anastomoses actually functioned 8 hours and 40 minutes and 8 hours and 25 minutes in the 2 experiments. The animals were given continuous nursing attention. Small doses of morphia and rare whiffs of ether sufficed to keep them soundly asleep.

At the conclusion of the experiments, the anastomoses were examined (on the "A" side of the arterial union and "B" side of the venous) by inspection, palpation, filling tests, and finally by escape of blood "beyond" the points of union. In every case the anas-

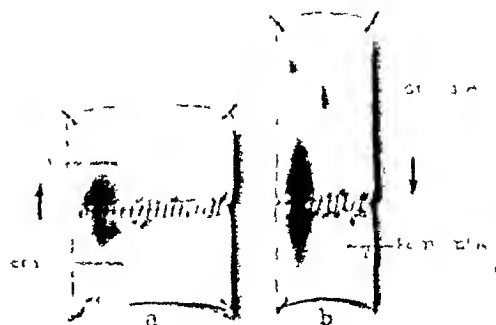


Fig. 2. The carotid femoral and jugular femoral anastomoses from experiment 13 after 8 hours of function. This situation accurately represents those found in examinations of the other suture anastomoses. Natural size.

tomoses were found to be functioning competently. After tying the vessels and removing the connecting portions for examination, animal A was killed. The wound of animal B was sutured in layers with fine silk, and this animal was returned to its cage.

In the two experiments the B animals recovered promptly.

There was no wound infection. The condition of the opened vessels shown in Figure 2, a drawing from the specimens in experiment 14 was typical of the group.

In the two control experiments the anesthesia and operative procedures were identical with the above. Both animals in each set of partners survived. The anastomoses functioned briskly, and the same examination tested their freedom from thrombosis. At the conclusion of these procedures the A animals were not killed. The wounds of both partners in the crossed circulation preparation were sutured with fine silk, and the 4 recovered promptly, without infection or other untoward sequelae. These experiments were terminated in each case after the anastomoses had functioned 9 hours and 15 minutes. Table I presents the essential data of the foregoing.

In two additional experiments the leg of animal A was subjected to mechanical trauma produced by blows with a blunt instrument, under full anesthesia. This was carried out rapidly and vigorously, and the



crossed circulation may be in order. Though the technique of parabiosis is the easiest of the three to carry out, the method has other pitfalls. Conclusions, to be convincing, should be based upon a number of experiments. When the time element is introduced, the relationship of the significant maneuver should be cleared of all doubt. For, as Dragstedt and others have pointed out, unexplained deaths, not associated with characteristic lesions and quite unpredictable, are not uncommon.

The crossed circulation techniques are more difficult to carry out and require, on the part of the experimenter, a very clear concept of the problem in hand. Some of the experiments noted so far departed from the comparison to the physiological state that analogies drawn from them are of doubtful validity. Doubt surrounds other results because of the failure of the authors to offer evidence that circulation was in progress during the experiment. Finally, in at least 2 cases, adaptations of the method were used which were far too crude to justify significant conclusions.

In general, we feel that parabiosis is best adapted to the study of effects that are relatively subtle, that are progressive, and that take place over a period of days or weeks. Vascular parabiosis and crossed circulation, on the other hand, seem best adapted to experiments of short duration in which relatively gross changes are anticipated.

#### CONCLUSION

Two varieties of trauma affecting the leg of one animal perfused by the blood of a second failed to evoke evidence of shock in the second animal. This result tends to derogate the postulate that a lethal toxin is formed in traumatized tissues.

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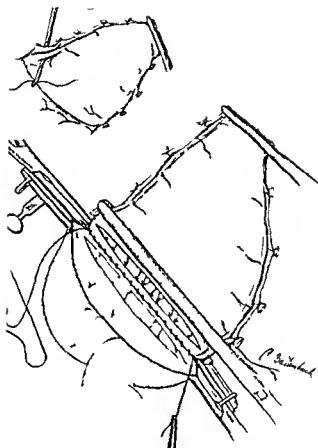


Fig 5. Transverse section of the stomach, showing the pyloric antrum and the lesser curvature. The drawing illustrates the internal structure of the stomach, including the rugae (folds) of the mucosa and the pyloric region. The text is a transcription of the drawing's content, which appears to be a mix of English and German words, possibly a misinterpretation or a specific dialect.



# CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, NORTHWESTERN UNIVERSITY

## TECHNIQUE OF GASTRECTOMY

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**G**ASTRIC resection today offers the only curative procedure for malignancies of the stomach. Although, theoretically, total extirpation of the stomach is probably the operation of choice, this procedure is associated with too high a mortality to be of practical value. Subtotal gastric resection with the removal of the greatest possible portion of the stomach and of the surrounding tissue, such as the lesser and gastrotocolic omentums and the lymph glands in these structures, gives the best results. In the advanced cases, in which the malignancy has invaded the liver, transverse mesocolon, transverse colon, anterior abdominal wall and pancreas, gastric resection is only a palliative procedure, it removes an ulcerating, bleeding, or obstructing tumor, relieves pain, but does not give a permanent cure or appreciably lengthen life.

There are many types of gastric resection, the descriptions of which are beyond the scope of this paper. The operation that has given us the best results is the Pólya modification of the Billroth II. The technique of the Billroth II, as carried out in our practice, will be discussed and the pre-operative and postoperative care briefly summarized.

### PRE-OPERATIVE TREATMENT

The amount of pre-operative treatment depends upon the general condition of the patient and the type of gastric malignancy. From the point of view of pre-operative management, the gastric lesions may be divided into two groups: (1) stenosing tumors which produce pyloric obstruction and gastrectasis, (2) tumors which do not produce obstruction. The stenosing tumors lead to a gastric dilatation, retention of food, hypertrophy, and edema of the gastric wall. These effects of the obstruction can be overcome by lavage of the stomach to free it of food residue and by constant aspiration through a Levine tube for

several days. During this period the patient's water balance is maintained by the daily administration of 3,000 to 4,000 cubic centimeters of 5 per cent dextrose in Hartmann's solution, by intravenous drip. The non-obstructing tumors do not lead to these stomach changes and do not require this gastric decompression. Patients are allowed liberal amounts of high carbohydrate, non-residue foods and a large amount of liquids. If a marked anemia is present, blood transfusions are indicated before operation.

### ANESTHESIA

The choice of anesthesia in patients with gastric malignancies, especially if associated with loss of weight and debility, is of importance. Patients who are in fair general condition are given a combination anesthesia of avertin (tribrom-ethanol) in doses of 70 to 80 milligrams per kilogram body weight, supplemented by ethylene or 1 per cent novocain local infiltration. Emaciated patients with possible kidney damage are better operated upon under morphine-scopolamine analgesia and local infiltration of 1 per cent novocain and supplemented with ethylene when necessary.

### OPERATIVE TECHNIQUE

The operative technique for gastrectomy may be divided into various steps, such as (1) abdominal incision, (2) determination of operability, (3) mobilization of stomach, (4) gastro-intestinal anastomosis.

The abdominal incision most suitable for gastrectomy is the left paramedian incision. However, if the lesion is located high on the fundus or cardia of the stomach, the exposure through this incision may be inadequate. In these cases the operation is facilitated by enlarging the paramedian incision with a transverse incision across the left rectus and extending to the lateral abdominal muscles.

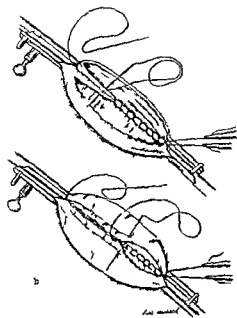


Fig 6 a Th stom ch amp tat d a d a out n s  
 igut sut ep ses thro gh li th laye f th st ma h  
 nd j num uniting tl p at r w ll f th stomach t  
 th jeju m b is the suture re h th lesser curv ture  
 t is arri d over th a t i alia a continu ss tu e  
 through the mucosa At the gr at curv tu th sut  
 is tied t its sho t end.

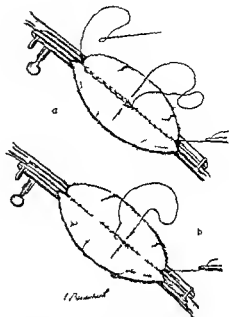


Fig 7 Th mu al ut e d scribed in Fig 6  
 o i n d back a a nt u s ser m scula s tur and  
 tied t th se muscular tur f the post n l and  
 ut le n th p it s suture nt c b Th p st t  
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procedure the lesser curvature of the stomach is freed of its peritoneal covering. The stomach is now lifted up and turned back over the left costal arch so that the posterior surface may be inspected. The gastrisplenic ligament vasa brevia arteries and adhesions are cut between forceps and ligated.

The fourth step in the procedure of gastrectomy is the performance of the gastrojejunal anastomosis. The stomach which has been extensively mobilized is brought down from beneath the costal arch and grasped with a Lane intestinal clamp as high as possible above the tumor and the redundant stomach reflected over the left costal arch so as to make the posterior surface easily accessible. The first loop of jejunum is brought through an opening in the transverse mesocolon and is approximated to the posterior wall of the stomach so that it runs from lesser to greater curvature in an antiperistaltic direction (Fig 6 opposite p 611). The segment of jejunum between the stomach and duodenojejunal angle is made as short as possible without causing too much traction on the suture line. A second Lane intes-

tinal clamp is applied to the jejunum which is approximated to the posterior wall of the stomach and the forceps are fixed in position. The jejunum is attached to the posterior wall by a continuous Lambert catgut suture. After the completion of this suture the distal segment of stomach is clamped and amputated about 1 centimeter from the Lambert suture. The jejunum is then opened about 0.5 centimeter from the Lambert suture. The cut edges of the posterior wall of the stomach and jejunum are sutured with a continuous over and over suture grasping all three layers (Fig 6). This suture is started at the greater curvature and progresses toward the lesser curvature. When the anterior wall is reached instead of grasping all three layers only the mucosa is sutured along the anterior wall. When the greater curvature is reached the ligature is tied to the short end and is then reversed grasping the serosa and muscularis of the anterior wall of the stomach and jejunum (Fig 7). When the lesser curvature is reached this ligature is tied to the continuous seromuscular suture of the posterior wall and is then cut leaving the posterior suture

with its attached needle intact. The clamps are now removed. Following this, the posterior sero-muscular suture is continued along the interior wall as a third layer suture. The entire suture line is reinforced with interrupted silk Lembert sutures. Along the lesser curvature of the stomach where the stomach has been freed from its peritoneal covering, the anterior and posterior walls are approximated by interrupted Lembert sutures, thereby burying the deperitonealized area of the lesser curvature.

The suture line is now drawn through the opening in the mesocolon (Fig. 8). The stomach is attached by interrupted Lembert suture to the edges of the opening in the mesocolon. If the remaining stomach is short, it may be impossible to pull it down through the opening in the mesocolon. In these cases, the opening may be closed around the loops of jejunum.

The abdominal incision is closed without drainage of the peritoneal cavity. The incision is closed with interrupted sutures in three layers. Catgut is usually used in the posterior sheath or rectus, transversalis fascia, and peritoneum which are taken as one layer and in the anterior rectus fascia. Interrupted silkworm is used in the skin. In debilitated patients with poor healing properties, interrupted silk sutures may be used throughout all layers.

#### POSTOPERATIVE TREATMENT

Immediately after the operation a blood transfusion is given. Following this, transfusions of blood are repeated as conditions warrant. During the first 4 or 5 days, the stomach is kept decompressed with a Levine tube and constant suction. During this period the water balance is maintained by the administration of 3,000 to 4,000 cubic centimeters daily of 5 per cent dextrose in Hartmann's solution. About the fifth or sixth



Fig. 8. a, The mistoma is reinforced with a layer of interrupted Lembert sutures. b, The posterior wall of the stomach is sutured to the mesocolon by interrupted sutures. c, The anterior wall of the stomach is sutured to the mesocolon.

day the Levine tube is clamped off and fluids are given orally. If the fluids are tolerated, the Levine tube is removed and the diet is gradually increased.

The general postoperative care is essentially the same as that of any laparotomy patient. He is encouraged to change position in bed and to sit in a semi-recumbent position in order to avoid pulmonary complications.

Patients with a malignancy have poor healing properties so that it has been our practice not to remove the tension sutures of the abdominal incision for at least 2 weeks, and, if the patient is emaciated, they are left in as long as 3 weeks. Many eviscerations may possibly be avoided by using this precaution.

## RETRO ESOPHAGEAL GOITER

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**R**ETRO ESOPHAGEAL goiter while not a surgical rarity is sufficiently unusual to warrant a report of 4 cases. The object of this discussion is first to place on record these case histories and second to show that this anatomical variant of goiter constitutes a definite clinical entity which with the aid of a few simple laboratory examinations may be accurately diagnosed before operation.

It has not been an uncommon experience especially with adenomatous goiters to find at operation small projections of thyroid tissue lying in the tracheo-esophageal groove or in the cleft between the esophagus and the vertebral column. Failure to visualize these masses due to incomplete delivery of the thyroid lobe is undoubtedly responsible for the many so called recurrences following thyroidectomy for adenomatous goiter. However it is not this variant of goiter to which I refer in this paper. The variety encountered in the following cases has passed in its growth mesially from the postero-internal aspect of the thyroid lobe across the midline between the pre-vertebral fascia and the posterior surface of the esophagus.

It is probable that the factor influencing the growth of retro-esophageal goiter is similar to that which determines the development of a substernal goiter; the direction of growth in the line of least resistance. In the initial enlargement of the gland the greatest bulging usually occurs anteriorly and laterally. However after the goiter has become large the pretracheal muscles become more or less unyielding and further growth may occur in the direction of least resistance either subternally or along the fascial plane behind the esophagus. As Pemberton points out the relative greater frequency with which retro-esophageal goiters are encountered in secondary operations for recurrent disease may be explained by the fact that the tissues anteriorly and laterally are unyielding because of the presence of scar tissue. However it seems more likely that in the so called recurrent cases these projections do not develop subsequent to operation but were overlooked by the surgeon who failed to dislocate the thyroid lobe completely. The absence of adhesions and the ease of delivery of the retro-esophageal projection in one of the described cases would seem to corroborate this viewpoint.

A well defined retro-esophageal goiter will in variably cause symptoms which if carefully analyzed will be found to be out of all proportion to any obvious anterior and lateral thyroid enlargement that may be present. In our 4 cases herewith reported all complained of attacks of choking brought on especially when turning the head to the side opposite to the point of entrance of the goiter in the retro-esophageal space. This was more evident with the patient in the recumbent position. One patient developed attacks of dyspnea which were relieved by inclining the head toward the affected side. This was corroborated by the findings at operation. One patient complained of frequent spells of coughing which came on invariably after retiring at night. Assuming an upright position often brought relief. A sense of constriction in the neck was noted by all the patients. One patient complained of difficulty in swallowing which however was not constant. In 1 instance the overlooked retro-esophageal extension was a factor in the continuation of severe thyrotoxic symptoms. The outstanding symptom in 2 instances was hoarseness which was variable in intensity and duration. The most recent patient disclosed a paralysis of the right vocal cord on the same side of entrance of the retro-esophageal goiter.

It may be extremely difficult to make a diagnosis of retro-esophageal goiter on the basis of physical signs alone. If the antetracheal portion of the goiter is definitely enlarged a clinical diagnosis may be impossible. If the thyroid isthmus is insignificant the finding of anterior displacement of the trachea especially against the upper manubrial edge should cause the surgeon to suspect a retro-esophageal extension. In the most recent case it was possible to palpate the trachea pushed forward by a large adenoma which could be moved from left to right behind the esophagus. In 3 of the 4 cases the abnormality was not suspected before operation. In the 3 remaining instances the retro-esophageal position of the goiter was diagnosed clinically.

In attempting to seek a more graphic method of depicting the presence of a retro-esophageal goiter before operation and to fortify the clinical diagnosis by some exact method in 1933 I had a lateral roentgenogram of the neck made on the third case reported here. This film indicated a

well defined anterior displacement of the trachea. Then in order to outline the position of the esophagus in relation to the trachea, the gouter, and the vertebral column, another lateral roentgenogram was made at the moment of swallowing a mouthful of bismuth. This clearly delineated the displacement of the esophagus by a mass behind its posterior surface. The X-ray films of the fourth case (Fig 5) disclosed, in addition, a narrowing of the upper esophagus by the posteriorly placed adenoma. I believe that these 2 methods of X-ray examination are valuable aids to the surgeon in arriving at a pre-operative diagnosis of retro-esophageal gouter.

At operation, removal of the retro-esophageal projection may offer little difficulty. If this portion of the gouter is large, the danger of injuring the recurrent laryngeal nerve is real. In 2 of the reported cases, it was possible to roll out the posterior projection while dissecting the major portion of the lateral lobe and to remove it with the remainder of the gouter. In the 2 other cases this maneuver was impossible. Realizing the danger of recurrent nerve injury, I resected the major part of the lateral lobe leaving the retro-esophageal portion *in situ*. All severed vessels were then tied so as to free the operative field of clamps. A temporary ligature was then placed about the inferior thyroid vessels in order to control bleeding from its branches. The posterior portion of the gouter was then dissected out of its bed in a practically bloodless field, without endangering the integrity of the recurrent nerve or parathyroid bodies.

#### CASE REPORTS

**CASE 1.** Mrs. I. H., aged 53 years, was first seen on November 15, 1928. She complained of a gouter of 20 years standing, with recent increase in size especially on the right side. For the preceding 4 years she had noted increasing nervousness, palpitation, and a loss of 30 pounds in weight. She also complained of choking sensations which were aggravated by turning the head toward the left side in a reclining position. In addition she had the sensation of constriction about the neck.

Examination showed an elderly woman quite nervous. There was no exophthalmos. There was moderate dental caries. The heart was somewhat enlarged to the left and was totally irregular. Pulse deficit amounted to 20. Pulse rate was 160. Blood pressure, systolic 170, diastolic 90. Laryngeal examination was negative. She was admitted to the New York Hospital on November 26, 1928. Laboratory tests revealed a negative urine, a negative Wassermann and a normal blood count. Basal metabolic rate on November 20, 1928, was plus 83 per cent. Following, rest in bed, the administration of Lugol's solution, a high caloric diet, etc., the patient's basal metabolic rate dropped to plus 51 per cent within 10 days.

Operation was performed on December 14, 1928. Because of the large size of the gouter, the pretracheal muscles were divided transversely. There were numerous adenomas, some solid, some cystic, extending into the lateral recesses

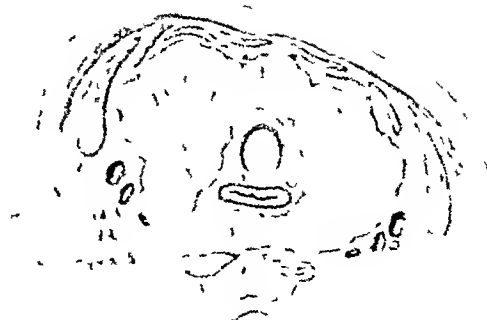


FIG. 1. Cross section of the neck showing diagrammatically the retro-esophageal gouter and trachea. The relative position of the recurrent nerves and inferior thyroid vessels should be noted.

of the neck and partly beneath the sternum. Great difficulty was encountered in attempting to dissect the right lobe. It was finally determined that this was due to a large adenoma which passed posteriorly between the esophagus and vertebral column (Fig. 1). The right lobe and still more extensively resected and the bleeding points were ligated. A temporary ligature was then placed around the inferior thyroid vessels and by a combination of sharp and blunt dissection the retro-esophageal mass was finally dissected out to the vessel and removed. The recurrent laryngeal nerve was re-anastomosed. A subtotal resection was then done on the left side. The adenoma, which had grown on behind the manubrium, was removed.

After operation this patient did well. Laryngeal examination on the fourth day after operation was negative. The pathological examination of the removed gouter disclosed numerous adenomas with some hyperplasia. The patient was discharged with the wound completely healed on the twelfth day after operation. The basal metabolic rate was plus 2 per cent. She has remained well to date.

The follow-up on this patient is extremely interesting. She developed a year later signs of an abdominal tumor which upon operation proved to be retinoblastoma of the transverse colon. This was reported in the *Annals of Surgery*, 93: 59, p. 51.

**CASE 2.** Mrs. H. S., aged 30 years, referred by Drs. W. Klingman and J. Hau, was first seen October 2, 1933, at which time she complained of a gouter of 6 months duration. She stated that for the preceding year she had been troubled with a persistent cough which became more evident at night after retiring. These coughing spells were productive of a small amount of mucus. In addition she experienced frequent attacks of hoarseness which did not respond to therapy and which spontaneously subsided after a day or two. For the past 5 or 6 months she had been conscious of a sense of constriction about the neck. The attacks of coughing, at night time were relieved when she assumed an upright position. In addition, she presented symptoms of mild thyrotoxicosis: palpitation, nervousness, dyspnea on exertion, mild exophthalmos, a loss of 5 pounds, and tremor.

Examination showed a well developed young woman, troubled with a persistent dry cough. The skin was moist. There was slight exophthalmos and the thyroid gland was uniformly enlarged and soft. The lateral borders could not

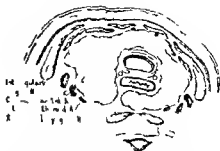
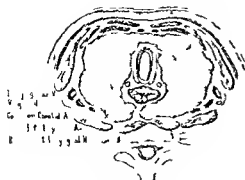


Fig. Cross section of the neck showing the trachea and the esophagus. The position of the various structures is indicated.

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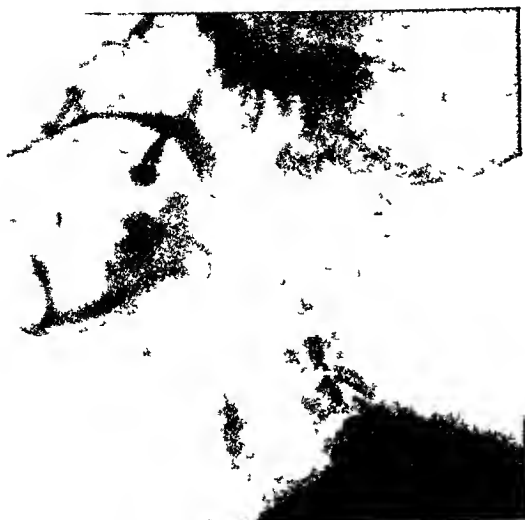


Fig 4 Pre-operative lateral roentgenogram of the neck, Case 4, showing the anterior displacement of the trachea which is caused by the presence of a mass in the retro-tracheal region by a retrotracheal mass



Fig 5 Pre operative lateral roentgenogram of the neck, Case 4, immediately after the ingestion of a barium mixture showing the anterior displacement and angulation of the esophagus by a retro esophageal mass

thyroid tissue extending posteriorly across the midline between the esophagus and the vertebral column (Fig 3). In order to protect the integrity of the recurrent laryngeal nerve, the right lobe was partially resected and bleeding points were ligated. A temporary ligature was placed around the inferior thyroid vessels. By a process of blunt and sharp dissection, the retro esophageal projection was delivered into the wound. The absence of adhesions in the region, and the ease of delivery of this projection indicated that manipulation at this site had not occurred during the first operation, and that the surgeon had completely overlooked the presence of the retro esophageal extension. A subtotal resection was performed on both lobes, and the wound was closed.

Pathological examination of the specimen revealed scattered areas of hyperplasia with papillary projections of the acinar epithelium. The patient did extremely well after operation. Laryngeal examination was negative. The basal metabolic rate dropped to minus 5 per cent. The patient was discharged on the twelfth day after operation in excellent condition. Since then there has been no return of the attacks which occurred so frequently before, and the patient has remained well.

I am indebted to Dr. Richard Lewisohn for permission to report this case. This patient was on his service at the Mt. Sinai Hospital recently and was operated upon by him. He recognized clinically the probability of a retro-esophageal goiter and demonstrated the condition by lateral roentgenograms of the neck as already indicated. The clinical diagnosis was confirmed at operation.

CASE 4. S. F., married housewife of 42 years, was admitted to the surgical service of Dr. Lewisohn on February 27, 1935, complaining of the presence of a goiter of 7 years' duration, and hoarseness and dysphagia of 9 months'

duration. During the past 7 years, she had noted a gradually increasing swelling in her neck, confined mainly to the left side. Aside from the presence of the swelling, she had no other symptoms until 9 months before admission when she suddenly noted hoarseness. This persisted with varying intensity up to the date of her admission. During this same period, she noted frequent attacks of choking brought on especially after inclining her head toward the left side. Rotating her head again toward the right side relieved the choking sensation. In addition, she noted intermittent difficulty in swallowing.

Examination showed an obese female with facial hirsutism, no exophthalmos. There was a large adenoma occupying the right side of the neck and the isthmus, and a smaller, freely movable, cystic adenoma, in the left lobe of the thyroid. It was possible to palpate the trachea which seemed to be displaced forward by a posterior mass. It was possible to palpate an adenoma which seemed to be attached to the right lobe and pass behind the trachea, and could be moved slightly from side to side. Laryngeal examination revealed a right recurrent nerve paralysis. The right vocal cord was in the midline. There was a small amount of outward motion in the right arytenoid but the cord itself was immobile. The left vocal cord moved normally. Blood pressure was 105 systolic, 70 diastolic. Blood count was negative. Hemoglobin was 90 per cent. The urine was negative. Blood sugar was 95 milligrams. Blood Wassermann was negative. Basal metabolic rate was plus 7 per cent. X-ray examination of the chest showed a moderate degree of diffuse dilatation of the aorta. There was no evidence of intrathoracic goiter. A lateral X-ray of the neck disclosed the trachea pushed forward by a retro-tracheal mass (Fig 4). Lateral X-ray of the cervical esophagus following the ingestion of barium, showed some constriction of the esophagus and displacement of this organ anteriorly by a retro esophageal mass (Fig 5). A diagnosis of multiple non-toxic adenomas of the thyroid with retro-esophageal extension was made.





HYPERTROPHIC CRICOPHARYNGEAL STENOSIS<sup>1</sup>WILLIAM L. WATSON, M.D., F.A.C.S., AND FREDERIC W. BANCROFT, M.D., F.A.C.S.,  
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**I**N the recent literature, attention has been directed to benign disorders of the upper esophagus resulting in dysphagia and malnutrition. This type of dysphagia is usually the result of unstable emotional states, malnutrition, and anemia especially that form of anemia associated with glossitis, vitamin deficiency, achlorhydria, and splenomegaly. It is generally believed that the upper and lower ends of the esophagus are normally in a state of tonic closure and that the usual cause of benign spastic dysphagia is some neuromuscular dysfunction. At the entrance of the esophagus the comparatively powerful cricopharyngeus muscle is responsible for its tonic closure. Branches of the glossopharyngeal (ninth cranial nerve) and the vagus (tenth cranial nerve), together with some fibers of the cervical sympathetic system, form the pharyngeal plexus, which in turn innervates the constrictors of the pharynx as well as the pharyngeal mucosa. Therefore the cricopharyngeal muscle is subject to both sensory and psychical stimuli. Any series of sensory stimuli, if continued to a point of causing irritation of the mucous membrane, would therefore set up a vicious cycle, as would also psychical stimuli resulting from severe emotional reactions.

Hypertonicity, spasm, or inefficient relaxation (achalasia) may lead to passive congestion, edema, round cell infiltration, hypertrophy, and degeneration of muscle fibers, and finally, fibrosis. It is significant, however, that long standing so called cardiospasm of the lower esophagus does not lead to muscular hypertrophy of the cardiac portion of the esophagus.

We have had the opportunity of examining and operating upon a patient who presented a benign tumor of the cricopharyngeus muscle due to hypertrophy and degeneration of its fibers, together with intracellular edema, probably as a result of a long standing neuromuscular dysfunction. Our pre-operative diagnosis was incorrect in that we expected to find a parathyroid tumor or an atypical thyroid tumor encircling the esophagus. With the tumor exposed, we believed it to be an inoperable neoplasm and, thinking to afford the patient a certain degree of palliation, carried out what we believe is a new operative procedure. The patient is now alive, well, and symptom free, 20 months after operation. Pre-operative data and postoperative follow-up are complete, and as material was obtained for microscopic study, we believe that it is justifiable to report this case in some detail, hoping that our



Fig 1

Fig 1 Pre operative lateral view of the neck showing the smooth mound like swelling in the midline. It was at first thought to be of thyroid gland origin.



Fig 2

Fig 2 Roentgenogram showing the smooth funnel shaped narrowing of the esophagus opposite the level of the

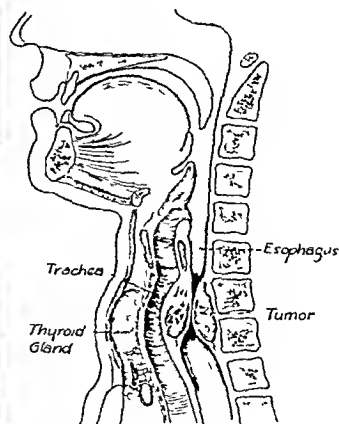


Fig 3

fifth and sixth cervical vertebra.

Fig 3 Diagrammatic sagittal section showing the esophageal obstruction, tracheal compression, and thyroid prominence which were brought about by the post-cricoid tumor.



Fig. 4 Diagrammatic section of the neck at the level of the esophageal lumen showing its relationship to the surrounding structures and adjacent to the thyroid gland.

observations may be of some help to the surgeon unexpectedly confronted with a similar situation.

The patient is a female, 40 years of age, first seen at the hospital for family physician, February 7, 1933, because of a piece of food lodged in the upper esophagus. She had a history of a thyroid enlargement of 6 years duration associated with a carcinoma of the thyroid. She was operated on 12 years before admission when she had a subtotal thyroidectomy. She had a feeling of food stuck at the level of the thyroid gland. She was definitely unable to swallow at and after the removal of the thyroid gland.

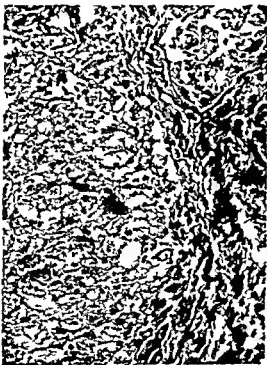


Fig. 6 Photomicrograph of the biopsy material removed at the operation. It shows edema and fibrosis of the layers with hyperplasia and degeneration of stratified mucosal layers.

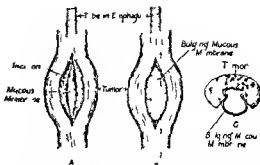


Fig. 5 Operative tips. A. Tube placed in the esophagus and a long tube inserted into the tumor. B. The tumor was removed. C. A cross-section of the tumor showing the tumor in the esophagus. The tumor was removed by the incision of the tumor in the mucous membrane.

She had been only able to swallow soft food. She had been unable to swallow solid food. She had been unable to swallow solid food. She had been unable to swallow solid food.

The tumor was a smooth rounded mass, 1.5 cm in diameter, located in the lower third of the esophagus. It was soft and elastic, and it was surrounded by a thin layer of connective tissue. The tumor was removed by the incision of the tumor in the mucous membrane.

Label: (1) finding showed (1) B. In the middle of the esophagus, there was a small, smooth, rounded mass, 1.5 cm in diameter, located in the lower third of the esophagus. It was soft and elastic, and it was surrounded by a thin layer of connective tissue. The tumor was removed by the incision of the tumor in the mucous membrane.

An exploratory operation was decided upon and carried out by Dr. R. E. P. and Dr. J. H. P. on March 24, 1933. The usual collar neck incision was made, and the esophagus was exposed.



Fig 7 A and B, Postoperative roentgenograms after ingestion of barium, showing the increased width of the esophageal lumen and its lateral position

both lobes of the thyroid were mobilized. After considerable careful dissection, it was decided that the tumor was inoperable and it was incised longitudinally along its left lateral border down to its mucous membrane which then bulged through the incision. On cut section, it was about 1 centimeter in thickness and it looked and felt like cartilage. A piece of this tissue was removed for biopsy purposes and a frozen section was done. A Levine tube was passed through the esophagus into the stomach. Both lobes of the thyroid were then replaced and a wick of gauze was inserted on each side and a routine closure was done without incident (Figs 3, 4, 5).

The material removed at operation for microscopic examination was described by Dr. C. Zent Garber as follows: "Macroscopical examination of the specimen removed at operation measured 7 by 3 by 3 millimeters. It was of a yellowish pink color, smooth surfaced and quite firm. Microscopical examination showed a border of dense fibrous tissue surrounding some small blood vessels. Adjacent to this there was much striated muscle. The fibers stained a dull pink, the cytoplasm was granular, the cell outline poorly marked and the nuclei stained poorly. No tumor cells or inflammatory cell reactions were seen. Further sections showed some degeneration of muscle fibers and some fibrous and adipose tissue."

The postoperative course was stormy and complicated by acute embolic nephritis, right otitis media, right mastoiditis, and an operative paralysis of the left recurrent laryngeal nerve. Her convalescence was slow but she was discharged from the hospital much improved 37 days after the operation.

Postoperative X-ray films after the ingestion of barium paste, have been taken periodically and show (Figs 7a and b), that the esophageal lumen is somewhat enlarged and is located to the left of its pre operative midline position. On fluoroscopy the barium is seen to pass through this area without delay.

The patient has made steady progress and is now robust and healthy. The neck mass has largely disappeared (Fig 8). Her voice is somewhat less husky, although the



Fig 8 Postoperative photographs of neck.

left side of the larynx is still partially paralyzed. She eats a full diet without any difficulty.

#### SUMMARY

Our findings, operative procedure, and results bear a striking similarity to the condition which Rammstedt first described in reporting his operation for congenital hypertrophic pyloric stenosis.

Bougienage in this case was attempted but the pathological condition found at operation showed clearly why adequate stretching of this area would not have been possible.

The procedure described has not been reported previously as far as we have been able to learn from a review of the available literature

NOTE.—Dr James B. Woods of Tangliangpu General Hospital, China, in a personal communication states that he has seen a member of this Club separate the

prolonged fit of temperature absolutely controlled his wife's symptoms of strictures of the esophagus. In a number of cases the symptoms persist and are treated some of these patients die of dehydration and starvation while others pass a variable chronic type of esophageal stricture while others have a satisfactory cure after a long delay. For a further name the author is indebted to the Chinese as any disease

## COMBINED ONE STAGE CLOSED METHOD FOR THE TREATMENT OF PHARYNGEAL DIVERTICULA<sup>1</sup>

THOMAS A. SHALLOW, M.D., F.A.C.S., PHILADELPHIA, PENNSYLVANIA

WITHOUT using too many cumbersome definitions and boring classifications the writer nevertheless deems it necessary to arrange pharyngeal diverticula in definite groups based on the literature to which he has had access and on his personal operative experience in 79 cases. Clarity of definition usually promotes the advancement of any subject. The time has come for more accurate classification of the so-called pulsion esophageal diverticula which really arise in the pharynx and should therefore be named accordingly pharyngeal diverticula. There are no recorded cases of true pulsion diverticula of the esophagus. The cases recorded as diverticula of the esophagus arise either opposite the bifurcation of the trachea or at the lower end of the esophagus. They are not pulsion in origin but result from periesophageal inflammation and are therefore traction diverticula. They are mentioned here to emphasize their difference in etiology from the pulsion pharyngeal diverticula.

### HISTORY OF PHARYNGEAL DIVERTICULA

These diverticula are usually incorrectly termed in the literature esophageal (Killian, Jamison and Moynihan). There is no doubt that credit for the first observation of pharyngeal diverticula belongs to Mr. Ludlow. He furnished illustrations and an accurate description of this then unknown condition to Dr. William Hunter in the year of 1764. Later descriptions were made by Monroe in 1811 and by Sir Charles Bell in 1816. The name of Matthew Baillie is also associated with an early description of this condition.

About 1850 Kluge had the idea of extirpating the sac. Nichaus in 1884 was the first to extirpate the sac.

The common method of treatment had been by ligatures. As early as 1848 Dendy attempted to

obliterate diverticula by means of caustics. In 1871 electricity in the form of faradization was used by Waldenberg. It is now obvious that since the year of 1848 these pharyngeal pouches were not as common as we have been led to believe. Furthermore it would seem that some of these ancient plans of conservative treatment have survived even to the present day.

The postmortem examination of Whitehead's patient reported in 1897 showed that the pharyngeal pouch consisted of all three coats of the pharynx and was observed at the junction of the pharynx and the esophagus. This is contrary to the belief that all of these pouches arise as herniations of the mucous membrane. While it is difficult to believe that a hernial sac can contain all of the musculature which makes up the parietal structure the writer has had a similar case. In the reporter's case the wall of the sac consisted of all of the coats of the pharynx. The pouch however did not arise from the junction of the esophagus and the pharynx but at a much higher level from the lateral wall of the pharynx.

While S. J. Mixer in 1894 had cut into one of these pouches and had removed enough of the sac to make the esophagus a straight tube from the spur up his operation was apparently not one of deliberate extirpation of the sac. After reading both reports carefully the writer believes that the operation performed by W. Joseph Hearn in 1896 and reported in 1899 was the first deliberate extirpation of the sac in the United States. Hearn's operation was performed in the Jefferson Hospital.

Girard of Berne in 1896 deeply impressed by the mortality of the operations that had preceded his two cases, he used a technique with which to invaginate the sac without opening into the esophagus. This method of treating the sac has

been used by Albert Edward Halstead J B Murphy, A D Bevan, and others.

Henry T Butlin's contribution in 1898 added very little to that already promulgated by his predecessors. His technique did not differ from Barrow's technique except that he used silk sutures instead of catgut.

In 1900, Richardson reported a plastic operation on the esophagus below the pharyngeal pouch. The writer can find no other recorded cases in which this procedure was found necessary.

A distinct contribution to this subject was by A Bois Barrow in 1905. Barrow used a bougie in the pouch during the course of the operation. This does not differ in principle from our present plan of treatment except that we now use the esophagoscope instead of the bougie in order to facilitate identification of the pouch. Barrow's method of treating the neck of the pouch does not differ from our present plan. He reflected back the muscle at the neck of the sac and ligated the mucous membrane inside of the reflected cuff then, by stitching over the muscles of the hypopharynx, he buried the ligated mucous membrane.

Since these early cases, many operations for the cure of pharyngeal diverticula have been advocated. These operations may be classified as the one and two stage operations. Here, nothing but extirpation of the pouch is considered because the writer has performed no other operation for the cure of pharyngeal diverticulum.

It is the belief of the reporter that all operations of extirpation of the sac were one stage procedures until 1910 when C H Mayo performed and advocated extirpation in two stages in order to avoid the possibility of a neck infection descending into the mediastinum. The technique of the two stage operation was developed by E S Judd and C H Mayo until the latter, in 1923, could report 74 two stage operations with but 3 deaths. The two stage operation has been adopted by Charles Gordon Heyd, Frank H Lahey, Eugene H Pool, and by many others. Lupke, in 1921, reported that he had operated upon 39 cases by the one stage method of extirpation of the sac. There were 2 deaths, 1 from mediastinitis, 1 from hemorrhage.

In the last analysis, the surgeon must be guided by his own experience. Thus far the writer has had no reason to abandon the one stage operation. Bensaude, Grégoire and Guénaux, in 1922 in discussing the statistics compiled by DeWitt Stetten, note that the mortality between 1900 and 1909 is lower than between 1880 and 1900. These three authors think that the tear of infec-

tion of the cellular tissues of the neck and of the mediastinum are without much foundation. These authors have collected 109 cases with one stage operations. In this series, there were 12 deaths of which 3 were caused by septic cellulitis of the neck. In 23 cases, there had been more or less prolonged suppuration of the peri-esophageal cellular tissue. These complications became rarer as operative technique improved (Bensaude, Grégoire and Guénaux).

Moynihan, in his scholarly analysis of this subject in 1927, has insisted that these pouches are from the pharynx and should be called pharyngeal.

#### THE SITE OF ORIGIN OF PHARYNGEAL DIVERTICULA

For many years it had been almost universally accepted that pharyngeal diverticula arose from Laimer's triangle. This belief persisted until 1908, when Killian wrote his epoch making article on the anatomy of the esophagus and pharynx. Killian, not being satisfied with the previous dissections done by Luschka and later on by Laimer resolved to study the region of the hypopharynx and the esophageal orifice.

Much of Killian's labor had gone for naught until Sir Berkeley Moynihan investigated the subject in 1927. In his article, Moynihan corrected the erroneous belief that pharyngeal diverticula arose from Laimer's triangular area. He pointed out that Laimer's triangular area is situated below the lower border of the cricopharyngeus muscle of the pharynx. He emphasized the fact that diverticula did not arise in Laimer's triangular area by stating that there were no recorded cases originating in this area.

Killian further demonstrated another possible area for the origin of the pharyngeal diverticula. He showed the presence of a defect below the cricopharyngeus muscle. He called this defect a slit. This slit is below the cricopharyngeus muscle and above the esophageal fibers. Killian's description is as follows. The slit that we see on each side between the pars fundiformis and the circular fibers of the esophagus is a very important area. Here in this slit the recurrent nerve passes through to divide into the anterior and posterior branches. Killian makes no mention of this area in its relationship to diverticula of the pharynx. It is quoted here because of the work recently reported by Moynihan on dissections made by J K Jamison. It is because of this original work done by Killian and confirmed by Moynihan, that we are attempting to establish in this series of cases the relative frequency of this site for the origin of pharyngeal diverticula.

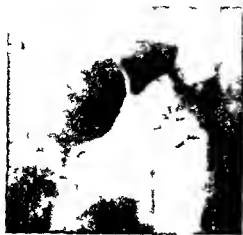


Fig. 1. Double diverticulum shown by X-ray plate

Killian's studies demonstrated that the lowermost bundle of the inferior constrictor muscle which he calls the sling, bundle of the pars fundi formis is the chief closing muscle of the esophageal opening. In the state of contraction it presses the opening of the esophagus together and holds it against the cricoid plate thereby producing a crescent shape with the concavity forward. In his text and by photograph he further points out the influence of the cricopharyngeus muscle in the production of pharyngeal diverticula.

The observation of Jamison while not original certainly has crystallized our knowledge of the subject. He observed not only the inferior branch of the recurrent laryngeal nerve but also a branch of the inferior thyroid artery and vein and a bundle of lymphatics passing through this hiatus. This anatomical observation of Killian and Jamison explains the symptom of hoarseness which was present in 9 of our patients. Likewise it explains the presence of hoarseness which temporarily followed 2 of our operations. A curious fact concerning the postoperative hoarseness was that it was not apparent immediately after operation but came on gradually after the fifth day. The hoarseness in both cases fortunately entirely disappeared.

That this slit is not an uncommon site for the origin of a diverticulum is further emphasized by the frequent presence of a branch of the inferior thyroid artery crossing the fundus of the sac. We have had occasion to ligate this vessel in at least 35 per cent of our cases. We believe that the deformity of the fundus of the sac as shown by X-ray pictures (see Fig. 1) is caused by the entrance of a branch of the inferior thyroid artery

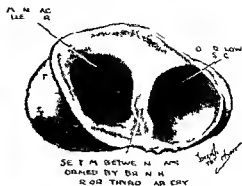


Fig. 2. Gross specimen of pharyngeal diverticulum has been dissected by a branch of the inferior thyroid artery.

into this slit. If this be so this supposedly unusual site of origin for diverticula would prove to be a common one for the origin of pharyngeal diverticula.

The presence of a double diverticulum (see Fig. 2) could be explained by the presence of a larger branch of the inferior thyroid artery which was too resistant to yield with the sac and consequently bifurcated the opening at the neck of the sac. Indeed it is our belief that a diverticulum can arise from any portion of the pharynx which is perforated by a branch of the inferior thyroid artery (see Fig. 3). This belief is fortified by the origin of a diverticulum much higher than the cricopharyngeus. The defect of the oblique fibers in the posterior lateral wall of the inferior constrictor muscle appeared as though it had been punched out with an instrument. The sac was covered with a thick muscular coat—the only diverticulum in this collection which had a muscular covering. The X-ray and bronchoscopic studies confirmed this high origin of the sac. Dr. Manges reported a rather large diverticulum originating a little higher than the average, apparently just below the larynx. Because of the unusual covering and high origin I performed a two stage operation. The second stage consisted not only of the removal of the sac but also of the repair of the pharyngeal defect.

Finally true pulsion diverticula have been observed by us to originate in one of three areas: (1) They have arisen most frequently in our experience from the commonly described area above the cricopharyngeus muscle either on the left or on the right side, more frequently on the left. In 4 of our patients the pouch originated

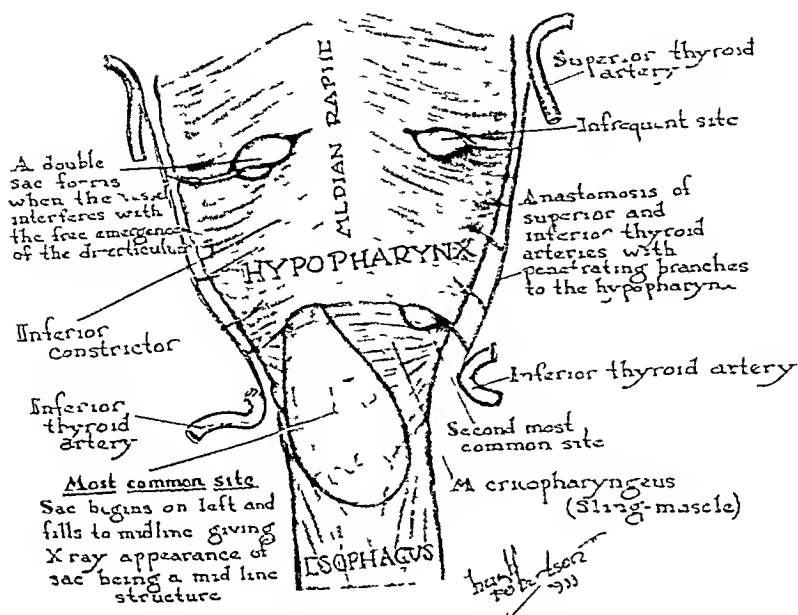


Fig 3 The pharynx, posterior view showing the various locations for the development of diverticula

from the right side of the pharynx. (2) The next place in the order of frequency for the origin of the diverticula in this series, was the Killian-Jamison area. This is on the posterolateral wall of the pharynx, below the cricopharyngeus and above the circular muscle fibers of the esophagus. Through this weak area the inferior laryngeal nerve, a branch of the inferior thyroid artery and a bundle of lymphatics pass. In this area more than 35 per cent of the pouches arose. (3) The location least frequent for the origin of the diverticula has been through the lower portion of the inferior constrictor muscle, a site for another branch of the inferior thyroid artery.

## PHYSIOLOGY

It would seem that some other factor or factors, aside from the neuromuscular co-ordination of the pharynx and the esophagus, must be considered in a careful analysis of the physiology of swallowing. The act of deglutition differs for liquids and for solids. The phenomena observed in swallowing liquids is manifested by a rapid rise of pressure within the pharynx, which is almost instantly followed by a projection of the liquids with great force into the esophagus. Second, in the course of swallowing solid food, there is a temporary arrest of the bolus of food in the

pharynx. The further passage of solid food depends upon the action of the constrictors of the pharynx. Analyzing these two accepted physiological facts, it would seem that a ready explanation for the beginning of herniation in the pharynx is found in the muscular weakness at one of the vulnerable points already described. Once begun in this manner, the further progress of the herniation is stimulated by each act of swallowing of liquid.

By experiment it has been demonstrated that at the beginning of deglutition there is a sudden rise of pressure, the result of a quickly acting force resident in the mouth or pharynx in consequence of which the liquid foods are rapidly shot down toward the end of the esophagus, peristalsis playing no part in the process. The proof of these statements was furnished by Meltzer. It was found as a result of many experiments by the aid of esophageal and pharyngeal balloons connected with tambours, that the pharyngeal and esophageal pressure was simultaneous when liquids were swallowed. From this it was inferred that liquids were projected or shot down. The pharyngeal and esophageal balloons are both compressed at the same instant. These facts demonstrate that deglutition consists of two phases.



Fig 4. Malignant diverticulum of the pharynx. The patient complained of regurgitation of food.

1. A rapid rise of pressure in the pharynx as a result of which liquid or semi liquid foods are suddenly shot down to the lower end of the esophagus.

2. A peristaltic contraction of the musculature of the canal which acting as a supplementary force carries onward any particles of food in the canal and forces the bolus through the esophago-gastric orifice which is now opened by a relaxation or inhibition of the sphincter cardiac muscle.

The immediate cause of the sudden rise of pressure was shown by Meltzer to be the contraction of the mylohyoid muscles. These muscles are probably assisted in their action by the contraction of the hyoglossus muscles as well as the tongue itself.

#### Symptoms of Diverticula of the Pharynx

1. Dysphagia is the most common symptom of diverticula of the pharynx. The dysphagia varies from absolute inability to swallow liquids or solids to a relatively small degree of inconvenience in swallowing. In the beginning when the pouch is small the individual is able to swallow after the pouch is filled but as the pouch increases in size it frequently assumes a position between the esophagus and the vertebral column so that when the pouch is filled it presses on the lumen of the esophagus to such a degree as to render swallowing utterly impossible.

2. Vomiting is a prominent symptom. Regurgitation of food from a partially filled sac is frequently an annoying condition. This varies from immediate regurgitation as soon as the sac is partially filled to regurgitation a number of hours after eating. Indeed stagnated food regurgitated at night often produces chronic bronchitis. In fact one of the first symptoms complained of by the patient is regurgitation of undigested food mixed with saliva.

3. Many patients complain of noisy deglutition. This symptom is commonly so annoying as to cause the patient to eat alone. A number of patients of the writer never ate in the presence of others or in public. One patient waited to eat until the rest of the family had dined.

4. Hoarseness is not an uncommon symptom. Nine patients in this series complained chiefly of hoarseness.

5. A tumor occasionally in the neck may be palpated. This sign was present in 5 patients of this series. Invariably a gurgling sensation could be detected beneath the fingers when the patient swallowed.

While the symptoms described when present are helpful in leading one to suspect the presence of a diverticulum the diagnosis is invariably made during X-ray or fluoroscopic examination. While the report of the roentgenologist's findings may usually be accepted as conclusive uncertainty arose in 3 cases of this series because of distortion of the fundus of the sac (see Fig 4). The question was settled conclusively by the esophagoscopist. One patient had a carcinoma in a pharyngeal pouch; another had a pharyngeal diverticulum. Subsequently resection of the hypopharynx and cervical esophagus showed a carcinoma in the fundus of one sac. This patient lived for 3 years following the operation. The other sac was distorted by adhesions and a branch of the inferior thyroid artery and was not malignant.

#### Prognosis

The question of mortality in diverticulum of the pharynx has undergone a revision in recent years. Now diverticula of the pharynx are recognized early. The sac does not reach the dimensions that were observed in our early series of cases; consequently now the patient's physical condition when operation takes place is much better than formerly. It was not unusual in our early cases to resort to gastrostomy preceding the operation for diverticulum. (For early procedure see the original paper by Chevalier Jackson and the author.) We have not done a preliminary gastrostomy on the last 30 patients.



## THE MORTALITY OF VARIOUS TYPES OF OPERATION

Much is said, by those who advocate the two stage operation, of the high mortality due to mediastinitis which follows the one stage operation. Where this opinion had its origin, we do not know, nor have we been able to find any record of the high death rate due to mediastinitis in recent years. Certainly, it has not been a complication in any of our 76 cases. We believe that mediastinitis should not occur any more frequently in the one stage operation than in the two stage operation. The easy access to the sac, its rapid separation from the lateral and posterior wall of the esophagus, is only possible when an esophagoscope is in the sac. The esophagoscope is of invaluable aid until the neck of the sac is reached, then it is temporarily withdrawn.

Secondary hemorrhage is often quoted as a complication of the one stage operation. This is without foundation in our experience. We have not had any secondary hemorrhages in any of our pharyngeal diverticula. In 1926, a death occurred due to secondary hemorrhage. This mortality was not in a case of pharyngeal pulsion diverticulum but it occurred in a patient suffering with a traction diverticulum. In this case, part of the pharyngeal wall was purposely resected. This patient is not reported in this series, as it is not a case of pulsion diverticulum.

Recurrence of the sac occurred in 2 patients of this series. In 1 patient, 67 years of age, there was a double diverticulum which involved practically all of the lower lateral pharyngeal wall. We believe that this recurrence could have been avoided if a longer interval than 6 months had elapsed between the removal of the first and second pouch. The second recurrence was in a patient in his late sixties with a very poorly developed musculature of the pharynx. This diverticulum arose from the Killian-Jamison area. Both patients have been re-operated upon by me, and there has been no recurrence in 10 years in the first and 3 years in the second case.

Pulmonary complications not infrequently follow the operation. Many of these patients have a pre-operative bronchitis as a result of overflowing of the contents of the pouch into the larynx. There is a spilling of the foul contents of the sac, usually during sleep, and thus infected liquid flows through the larynx into the bronchi, so that clinically, bronchitis is often an associated condition. One of our two fatalities in pharyngeal diverticula was due to a diffuse pneumonia.

Renal complication was responsible for the other death, the patient, 67 years of age, dying of uremia 48 hours after operation.



Fig. 5 Atresia of the esophagus. The barium had been introduced into the lower end of the esophagus through a gastrostomy.

Temporary pharyngeal fistula occurred in 5 of the early cases. This has been obviated in subsequent cases by an improvement in our technique.

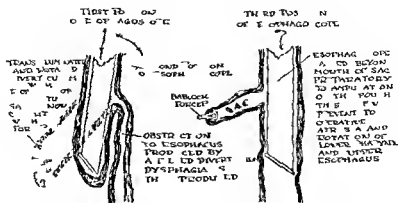
Wound infection as a complication has been noted to occur in those patients in whom the omohyoid muscle had been sutured. We now divide the omohyoid muscle only when such division is necessary in order to prevent trauma to the sac during its delivery. When it is necessary to divide the omohyoid muscle, it is not sutured.

We have now considered all the immediate and remote complications associated with our one stage operation.

We believe that the 2 deaths reported in this series might have been avoided if intratracheal ether anesthesia had not been used. We have discontinued its use and have substituted ether anesthesia by rectum. The last case was done under avertin anesthesia.

We are not in accord with those who believe that the two stage operation for diverticula indicates recent surgical progress, because the two stage operation is supposed to eliminate mediastinitis as a postoperative complication. Mediastinitis has not been a complication in any of the 76 one stage operations performed by us.

The writer admits that the two stage operation, as it is done today, far surpasses the older methods of treatment, by eliminating most of the dangers of the one stage operation as it was done in the past. The two stage operation is not logical, because, inasmuch as the diverticulum is a hernia of the pharynx, no effort is made in the two stage operation to repair the pharyngeal defect. This operation simply removes, in the first stage, the redundant sac, and, in the second procedure, the secreting mucous membrane of the remaining portion of the sac. The very basis of the cure depends upon traction on the pharynx which frequently distorts this structure as well as the upper portion of the esophagus, obliteration of the pha-



F 6 D am h g te n l man p l t n by th soph g s p t

ryngeal opening at the neck of the sac by scar tissue rather than by surgical repair as is done in the one stage operation.

One writer cautions those who contemplate doing the two stage procedure of the strong probability of entering the sac during the dissection necessary for the separation of the sac from the esophagus again he warns the operator of the probability of entering the sac while freeing it at the neck again he cautions the operator not to enter the sac while suturing it to the muscle in the incision. If he accomplished the delivery of the sac and its fixation without perforation other complications may be anticipated. Angulation of the pharynx may cause complete atresia. Necrosis of the sac may follow distention. The necessity of postoperative passage of bougies may ensue for at least a year. With the complications as possibilities and occasional cures

following the work of one of the great surgeons in this country any operation for diverticulum of the pharynx should be considered a serious one.

There is no doubt that the two stage operation is the operation of choice when the surgeon either discards the aid of the esophagoscope or when the aid of the esophagoscope is not available. This fact is strongly emphasized by the pathetic condition of two patients who were operated on by the one stage operation without the aid of the esophagoscope. Both of these patients were operated upon outside of Philadelphia. These patients were admitted to the Bronchoscopic Clinic both had atresia of the esophagus. One had paralysis of the recurrent laryngeal nerve. In one of the patients a portion of the esophageal wall had been excised and the pharyngeal pouch was not touched (Fig 5). The X-ray picture shows absolute block of the esophagus. The barium had been introduced into the lower end of the esophagus through a gastrostomy fistula. The writer did a reconstructive operation on the esophagus of each of these patients with the aid of the esophagoscope which

was introduced through the mouth and the gastrostomy fistula. Dr. Louis H. Clark assisted in these procedures. Both patients are now well and satisfactorily.

We believe that the operation of choice is the one which at its completion leaves the pharynx and the esophagus in their normal positions, not angulated, not stenosed. This operation should not only remove the redundant sac but repair the defect in the pharyngeal wall. In the ideal operation danger of rupturing the sac either in freeing it from its bed or separating it at the neck is reduced to a minimum by the aid of the



I g 7 Sh n th th erk d th t tel  
thy d gla d Tl sephas x pe the p h il  
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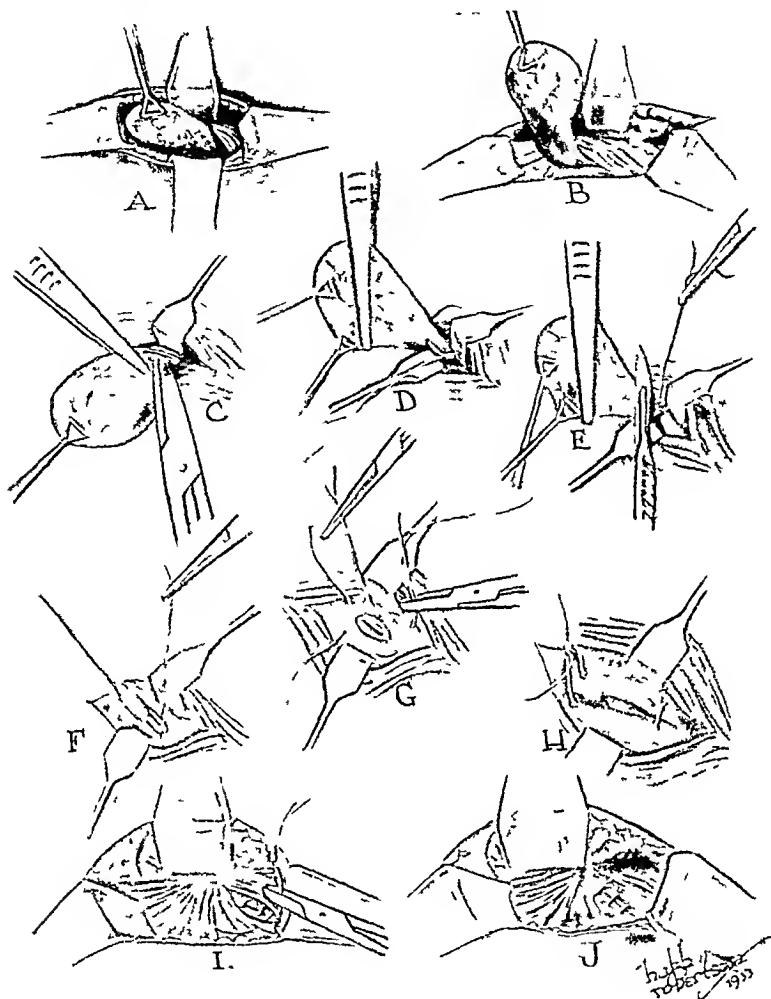


Fig 8 The various steps in the operative procedure

esophagoscope (Fig 6) The operation to be selected is the one which eliminates the risk of penetrating the sac during its fixation to the muscles in the incision We believe that all of these desiderata are combined in the one stage closed operation with the aid of the esophagoscope

This procedure was first advocated by Jackson, and he, in conjunction with Gaub, reported 2 cases in 1915 Since then, the writer has entirely modified the surgical technique The operative procedure which has been described herein is not Gaub's technique, but one which was devised by the writer

#### TECHNIQUE AT OPERATION

Under rectal ether anesthesia, intratracheal or avertin, the patient is prepared in the usual manner and an incision is made on the side on which the sac presents and along the anterior border of the sternomastoid muscle (Fig 7) The incision is to reach from the level of the hyoid bone to 1 inch above the sternum and is to pass through the skin, platysma, and deep fascia, exposing the anterior belly of the omohyoid muscle This muscle may be divided transversely, or retracted With this incision the external jugular vein may be exposed, and if it is, it should be divided and tied The common carotid artery and the internal

jugular vein are now exposed and retracted outward. If the thyroid gland is decidedly enlarged it is sometimes necessary to ligate and cut the superior thyroid artery. The trachea and the esophagus will be found to be encased in a common sheath which is to be incised, exposing the esophagus in the posterior part of the wound and the trachea anteriorly. After this incision has been made the trachea and thyroid are then retracted toward the midline.

The esophagoscope is introduced by the esophagoscopist. The sac is emptied by aspiration thereby avoiding expressing the contents into the larynx. The interior of the pouch and the lower pharynx are then painted with an antiseptic solution. The esophagoscope is then introduced into the fundus of the diverticulum and the sac transilluminated; then the esophagoscopist rotates the sac into the wound (Fig. 8 A). The sac is grasped with intestinal forceps and drawn upward and outward (Fig. 8 B). The esophagoscope is then withdrawn from the pouch. The sac is then freed to the junction of the diverticulum with the pharynx (Fig. 8 C). Care must be exercised to free all muscle fiber from its neck. The neck of even the largest diverticulum is seldom one half inch in diameter. A neck larger than this usually means incomplete dissection. The sac is then transfixed at its junction with the pharynx with a small intestinal needle carrying No. 1 chromicized catgut in much the same manner as a hernial sac is transfixed (Fig. 8 D). The neck of the sac is severed close to the pharynx (Fig. 8 E). The stump is cauterized with pure phenol (Fig. 8 F). After transfixation ligation and amputation the stump is invaginated with two mattress sutures of No. 1 chromicized catgut, one above and one below the stump (Fig. 8 G and H). These sutures penetrate only the submucous coat of the pharynx. This invaginated area is then covered by suturing together the cricopharyngeus and the inferior constrictor muscle. If the pouch originates at Killian's slit the cricopharyngeus and the upper circular fibers of the esophagus are united (Fig. 8 I and J). Here care must be exercised not to include the inferior laryngeal nerve. During this procedure of muscle repair the esophagoscope is in the esophagus. This detail is absolutely necessary in order to obviate stricture at the esophagopharyngeal junction. If this precaution be followed, none of the patients will require subsequent dilatation of the esophagus.

The incision in the neck is closed in layers, no drainage being used except a small piece of rub-

ber tissue or cell silk placed beneath the deep fascia.

#### RESUME OF STATISTICS

Age	
Youngest	4 years
Oldest	75 years
Average	59 years
Sex	
Male	84
Female	16
Length of disease	8 months to 4 years
Primary gastrostomy	8
Interval between operation and discharge	2 days
Type of patient	
Stage	6
Stage	3
Complications	
Acute dilatation of the heart	2—(recurrent)
Uremia	—(died)
Pneumonia	1—(died)
Anesthesia	
Intra-chloral	
Rectal	
Intubation	
Esophagostomy	
Dichloride of Iodine	2
Dilator of Esophagus	67

#### SUMMARY

- 1 In a series of 76 pharyngeal diverticula all operated on by the one stage method there were 2 deaths.
- 2 Seventy four patients had complete recovery.
- 3 None of the cases was complicated by mediastinitis.
- 4 None of the cases required postoperative esophageal dilatation.
- 5 The use of the esophagoscope prevents anastomosis stenosis and atresia of the esophagus.
- 6 Hoarseness is often a chief complaint.
- 7 There are 3 areas of the pharynx from which diverticula may arise.
- 8 The one stage method of operation is the reasonable method of treatment of pharyngeal diverticula of the pharynx.
- 9 The result depends upon rational surgical procedure and accurate approximation of tissues.

#### ADDITIONAL NOTES

Moyzhan (Surg. Gynec. & Obst. Vol. 54, 1932) believes that there is no need for operations in two stages. He has operated upon 15 cases and has never had any difficulty in obtaining healing by first intention.

Torck (Ann. Surg. Vol. 97, 1933) says: Thirty years ago the mortality was very high with the one stage procedure but in the last 5 years 60 cases have been recorded with a mortality of only 1.

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## DIVERTICULA IN THE ANTERIOR URETHRA IN MALE CHILDREN

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**D**IVERTICULA of the urethra may occur in both males and females. In males the diverticulum may be located in the anterior or in the posterior urethra and it may be congenital or acquired. In general it may be said that urethral diverticula are rare and in children especially rare. A brief survey of the literature reveals only a few cases in which the diverticulum was located in the anterior urethra in male children.

Because the condition is so rarely found with respect to the following case:

J. C. Ma... (name obscured) admitted to the Children's Hospital, February 14, 1914, the mother stated that the child was born at full term, weighing 7 lb. 10 oz., and was healthy.

During the first six months of life the child was healthy and gained weight normally. At the age of 18 months the child was brought to the hospital because of a swelling of the perineum.

The mother stated that the swelling was first noticed when the child was 18 months old. It was a small, painless swelling that increased in size when the child was crying or straining. It was located in the perineum, just above the anus.

The child had no other symptoms. There was no pain, no discharge, and no change in the child's general health.

On February 14, 1914, the child was brought to the Children's Hospital. The mother stated that the swelling had been present for about six months.

On examination the swelling was found to be a small, painless, fluctuant mass in the perineum, just above the anus. It was about 1 cm. in diameter.

The child was otherwise healthy. There was no discharge from the urethra, and the child's general health was good.

The child was kept in the hospital for two weeks. During this time the swelling did not change in size.

On March 11, 1914, the child was operated on. The swelling was found to be a diverticulum of the anterior urethra.

The diverticulum was removed. The child was healthy after the operation. There was no recurrence of the swelling.

The child was discharged on March 18, 1914. The mother stated that the child was healthy and happy.

The child was followed up for six months. There was no recurrence of the swelling.

bro... (text obscured) ... the diverticulum was located in the anterior urethra.

And... (text obscured) ... the diverticulum was removed.

The... (text obscured) ... the child was healthy after the operation.

There... (text obscured) ... the diverticulum was located in the anterior urethra.

The... (text obscured) ... the child was healthy after the operation.

There... (text obscured) ... the diverticulum was removed.

## DISCUSSION AND LITERATURE

Many theories have been advanced to explain the origin of this condition. It may be interesting to present briefly some of these theories.

One of the early authors who attempted to explain the origin of the diverticulum of the urethra was Allemier (1848). In his opinion the diverticulum of the urethra arises from a lack of development of the splanchnic mesoderm of the urethra. The condition being similar in many respects to hypospadias, with the difference that in the latter condition the defect includes all the urogenital apparatus.

According to De la Roche (1898) the diverticulum is due to a primary atrophy of the splanchnic mesoderm of the urethra.

Kaufmann (1904) believes that the diverticulum of the urethra results from a herniation of the splanchnic mesoderm of the urethra.

Thus... (text obscured) ... the diverticulum of the urethra.

The... (text obscured) ... the diverticulum of the urethra.

There... (text obscured) ... the diverticulum of the urethra.

The... (text obscured) ... the diverticulum of the urethra.



Fig. 1. Showing diverticulum of urethra. Note presence of catheter in urethra.

Petz, quoted by Bokay (1900), states that the diverticulum in his case was due to a congenital stricture of the urethra.

Watts (1900) expresses the following opinion as to the origin of urethral diverticula: "Since acquired true diverticula are usually the result of obstruction to urination, we should expect such an obstruction to be an important factor in the formation of urethral diverticula in early life. Such obstruction in childhood or intra-uterine life may be due to adhesions of the prepuce to external meatus, a congenital narrowing of the preputial orifice, or a congenital stricture of any portion of the urethra."

He then discusses the valve-like structures which occur in the urethra in certain cases and states that they may constitute a cause of obstruction. He notes that only in 2 of the cases which he studied (Huetter and Schluter) could the formation of the diverticulum be ascribed to valves in the urethra. In these 2 cases, at operation, a circular valve was found at the outer extremity of diverticulum.

He adds that in the case of Hendriks a valve-like structure was found which was apparently only a thickening of the urethral wall. Also, in some cases the valves mentioned as occurring at the anterior and posterior extremities of the diverticulum are merely secondary formations due to undermining of the urethral wall by the diverticulum as it increases in size. Bokay (1900) substantiates Watts' theory and states that the valves in one of his cases were formed in this manner. Watts has found that such valve-like structures are often present in acquired diverticula, resulting from perforation of the urethra.

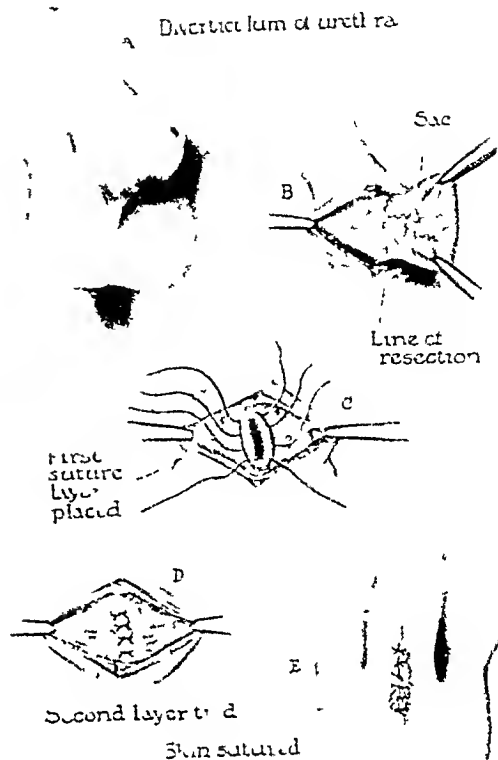


Fig. 2. A, The diverticulum. B, Isolation of the sac. Dotted line shows point of resection. C, First row of through and through sutures in place. The sac has been amputated just above the urethra. D, Second row of sutures. E, Suture of skin with fine silk.

A very interesting theory regarding the origin of urethral diverticula has been put forth by Suter (1908). He bases his theory on a histological study and concludes that diverticula of the urethra should be regarded as epidermal pockets communicating with the ventral wall of the urethra. He explains the embryology of the condition as follows: "The urethra originating from the genital furrow is covered with epidermis. A canal is formed which occupies the position of the future urethral canal. This canal is at first not closed on the side of the ventral surface of the future urethra, and there is a communicating bridge of epithelium connecting with the external skin. Normally this epithelial bridge (which remains squamous, while that within the canal becomes cylindrical) is absorbed." It is the persistence of this bridge which, according to Suter, gives the origin to diverticula and also to dermoids (Fig. 3).

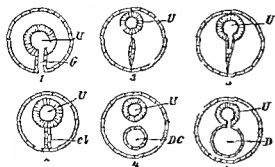


Fig. 1. From S. T. R. Sh. wing the ureth. U and the  
 th. l. m. l. remaining. Epithelial bridge. I. C. y. tic dilatation of the bridge. G. rise to the  
 DC. 5. I. C. m. p. l. c. s. e. f. i. h. p. h. l. b. n. d. g. 6. Dilatation of the complete l. d. bridge of epith. l. m.  
 G. rise to the duct. c. u. l. u. m. D.

Cabezas (1913) after a review of the various theories of etiology makes the following summary of his conclusions:

1. The incidence of diverticula is that the dilatation is especially in the distal part of the urethra due to the blood supply particularly the penile.

2. In the case of the diverticula, the disturbance is a defect in the development of the corpus spongiosum, being totally wanting in the glandular part. This can be explained only by an incomplete closure of the genital gutter.

3. The presence of a dilatation of the urethra is solely to be considered as a congenital anomaly, coinciding with that of the urethral diverticulum.

#### AGE

A review of the literature reveals that 4 cases in which patients were less than 1 year of age have been reported (Busch, Bokay, Cabezas, Ter-novsky); however, only 2 of these patients were operated upon. The case herein reported is 6 months of age, thus making it the third patient under 1 year of age who was operated upon.

It may be interesting to mention that in Lotzbeck's case the condition was diagnosed as late as the twenty-first year, although the symptoms had been present since early childhood.

The age incidence is given in the accompanying table.

#### LOCATION

Congenital diverticula of the anterior urethra occur on the ventral wall of the urethra. They are frequently located immediately behind the fossa

navicularis and open with a narrower or wider mouth into the urethra.

Denk states that in 23 cases of congenital diverticula which he gathered in the literature (including his own case) 14 arose just behind the fossa navicularis, 7 were in the pars cavernosa (fimbria) and 2 were in the pars bulbosa. Denk observes that the fact that the classical congenital diverticulum of the urethra is situated in the anterior portion is in accord with Kaufmann's theory as to their origin, namely that they are due to a retarded establishment of communication between the penile and glandular portions of the urethra.

Drachter states that congenital diverticula of the urethra are for the most part in the pendulous and scrotal portions and on the under surface of the urethra.

#### SIZE

The diverticular pouches are described as varying in size from a hazelnut to a walnut or pigeon's egg. In the case of Hendrickx (quoted by Watts) the size of the diverticulum was stated as being greater than the capacity of the bladder.

#### CLASSIFICATION

Diverticula of the urethra may be classified as congenital and acquired. The congenital diverticula are seen in the anterior urethra and in a large percentage of cases occur in young subjects, or in patients whose history, suggesting a urethral diverticulum, dates back to early life. Most says that when there is complete absence of any history of colic, thus precluding the possibility that a stone has descended to lodge in the urethra, and when there is no stricture or local lesion likely to give rise to a urethral or a para-urethral stone formation or other lesions to account for the origin, diverticula must be considered as congenital.

Likewise we must consider as congenital the cases arising in infants and also in children whose symptoms date to birth.

The acquired diverticula occur for the most part in the posterior urethra and the causes, such as urethral calculus, stricture, perforation of the urethra resulting from injuries or rupture of cysts, do not as a rule occur in childhood.

It has been suggested by early writers that the congenital and acquired varieties are to be differentiated by the fact that the former have a lining of mucous membrane similar in nature to and continuous with mucosa of the urethra, while the latter are devoid of a mucosa. It is generally admitted at this time that such a distinction is false, since inflammatory processes within a diverticulum may destroy the mucosa.



## ASSOCIATED PATHOLOGY

The urethral diverticulum not infrequently becomes the site of an inflammatory process caused by the stagnation of the urine within it and by superimposed infection. This may lead to a fistulous opening on the surface of the penis.

Calculus formation may occur in a diverticulum and in the case reported by Grube in a child of 5½ years, the sac contained 102 small stones. Stones were present in Calais's case.

The obstruction to the flow of urine, caused by the pressure of the filled sac upon the urethral lumen, leads to dilatation, infection, and destruction of the upper urinary tract.

In the cases which have come to autopsy (Boley, 2 cases; Ternovsky, Frontz), the effects of urinary stasis were evident in hydro-ureter, hydronephrosis, pyonephrosis, and pyelonephritis.

## SYMPTOMS

In some of the cases the diverticulum could be emptied completely by pressure only to fill up again subsequently. In my case it was possible to empty the diverticulum completely by the introduction of a catheter into the diverticulum. Pressure upon the tumor in my case discharged purulent fluid (urine and pus) at the external meatus.

However, when diverticuli become infected, certain changes occur in the tumor, namely, the skin becomes red and the diverticulum becomes attached to the skin, perforation of the skin with discharge of urine and pus soon occur. This train of events occurred in my case.

Although complete retention of urine is rare, this symptom was the direct cause of the patient's admission to the hospital in the case reported in this paper. The retention is mechanical in origin. The presence of the large diverticulum causes pressure upon the urethra, hence complete retention follows.

The outstanding clinical finding in this condition and one which occurred in every case which we have studied, is a tumor of the ventral surface of the penis. This tumor appeared in some cases during urination and in others is described as increasing in size during urination. In most cases it is noted that pressure on the tumor caused urine, or watery pus (in infected cases) to issue from the external meatus, and at the same time the tumor would diminish in size.

As a rule, the tumor is not attached to the skin and is generally described as being freely movable laterally, it is not tender on pressure nor are there external evidences of inflammation.

Disturbances of urination are encountered in the form of incontinence, or dribbling due to

slow emptying of the pouch, difficulty, a small stream, or the passing of urine by drops. In the case of Laugier-Anger (cited by Watts after Guyon) the patient voided normally, but the pouch filled first and then the stream appeared.

In the cases of Hendrick and Lotzbeck, Watts states that the urine was never voided in a stream. All the urine entered the pouch and was emptied by pressing the pouch with the fingers.

Nicholson states that in the absence of infection and urinary obstruction, it is quite possible for diverticula to be non productive of symptoms. Especially is this true of smaller ones which readily empty and are thus free of stagnating urine.

## DIAGNOSIS

As a rule the diagnosis of diverticulum of the anterior urethra is relatively easy. In my case the diagnosis was based upon the following:

1. The presence of a soft fluctuating tumor on the ventral surface of the penis.
2. Pressure upon the tumor was followed by a discharge of urine and pus at the external urethral orifice with a complete disappearance of the tumor.
3. Associated disturbances of urination, and finally complete retention of urine, necessitating the use of an indwelling catheter.
4. Diagnosis was verified by urethrogram (Fig 1).

## PROGNOSIS

The prognosis in these cases is entirely dependent upon the extent of the pathological changes which the diverticulum has caused in the upper urinary tract through obstruction and ensuing infection, and this means early diagnosis and early surgery before the onset of irreparable damage to the upper tract.

When the patient is operated upon before urinary stasis has caused serious damage to the upper urinary tract, the prognosis is good. This is seldom the case when the operation occurs after the urinary tract has been damaged.

## TREATMENT

Excision of the diverticulum is the best form of treatment in this group of cases. Invagination of small diverticula may be tried, but as the majority of patients have large sacs, the invagination is not feasible. Moreover, invagination of a large sac may produce urethral obstruction. The relative ease and simplicity of diverticulectomy and the fact that excision removes the sac once and forever, justifies the statement that excision of the sac is the method of choice.

DIVERTICULA OF THE ANTERIOR URETHRA IN MALE CHILDREN

A th D t	P u t g	Sympt ms	D t ymp- tom	M th d f di gn	Locati	Ty tenent	Revis	R marks
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S M te quoted by W 677	yrs	D blu T m und urface (penus) Tubo b ped b upho d with each lar	N t d	No pech	Fema avascular t er m	Exam f diverticulum and falk bl mme mch mch w re t t upo extremely f d	Good	
L P l 685	y yrs	b w lln und urface f pe ar Beach f size f hen g m	N t lated	I poet	U d urf ca f penus	lan f acc	N lated	Costal bold reticula with d t too f prim ry troupy f apur pougang m
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## DIVERTICULA OF THE ANTERIOR URETHRA IN MALE CHILDREN—Continued

Author Date	Patient's age	Symptoms	Duration of symptoms	Method of diagnosis	Location	Treatment	Result	Remarks
11 Bokay Case 2 1890	3 yrs	Difficult urination Continual dribbling Soft fluctuating tumor on under surface of penis Pressure on tumor caused flow of urine at meatus	Since birth	Inspection and catheterization	Lower floor of urethra near fossa navicularis	Operation for phimosis Operation for diverticulum refused	3 months later death of infant	
12 Bokay Case 3 1890	3 yrs	Dribbling frequent painful urination, pyuria Tumor size of hazel nut on lower portion of penis at penoscrotal junction became size of pigeon's egg on urination and emptied on pressure of finger	1½ yrs		Middle of pars cavernosa urethra	Excision	Death after 2 months	Autopsy showed dilatation of kidneys and ureters
13 Durand (quoted by Watts) 1901	2 yrs	Tumor on under surface of penis urethral	Not stated	Objective findings	Communicated with urethra by an orifice 1 cm in length 1 cm from external meatus	Excision	Not stated	All coats of urethra including spongy substance represented in wall of pouch
14 Essex 1908	5 yrs	Fluctuant tumor of lower border of penis	Not stated	Not stated	Penile urethra on ventral surface	Excision	Recovery	
15 Haberman 1911	8 yrs	Tumor on under surface of penis increased in size during urination Slow, small urinary stream	Not stated	Objective findings	Lower surface of urethra, from behind in saccular diverticulum to middle of penile urethra	Excision	Good	
16 Dunn 1912	8 yrs	During urination a balloon formed on under surface of penis It emptied by slow dribbling after act of urination was completed	Noted soon after birth	History and objective findings	Between behind of penis and in involved two-thirds length of penis	Excision	Excellent	
17 Cabezas Case 1 1913	1a 1st yr	Tumor on under surface of penis during urination Did not empty completely and urine could always be expressed from it	Since birth	Objective findings	Ventral surface of penile urethra	1 Artificial hypospadias 2 Resection of diverticulum 1½ years later	Good	Resection not done when first seen due to poor general condition Seen first under 1 year of age Operated at 5 yrs
18 Cabezas Case 2 1913	14½ yrs	Recurring attacks of retention Tumor of penis, size of walnut	Since birth	Objective findings	Cavernous urethra	Excision	Not stated	Diverticulum to retained a large number of small calculi
19 Larnovsky 1930	10 days	Tumor at root of penis Pressure on it caused urine to exude at external meatus Disappeared when catheterized and returned in hour later	Since birth	Inspection and palpation Verified by urethrogram Autopsy	Under surface of penis at border of scrotum	No operation	Death	Autopsy findings Hyptrophy of bladder wall, cystitis, hydroreters, pyelonephritis and pyelonephrosis
20 Larnovsky 1931	11 mos	Tumor on lower surface of penis visible beneath scrotal skin Pressure on this gave escape of watery pus at external meatus, and collapse of tumor	Noted soon after birth	Autopsy	Diverticular orifice (2 cm in diameter) on inferior wall of mid bulbous urethra	No surgery attempted	Death from urethral infection a week later	Autopsy findings Valve like fold at neck of diverticulum which allowed urine to distend the sac but prevented its emptying When the sac was distended the bulbous urethra was compressed from below upward Extreme hydroreters, hydrophrosis and pyonephrosis
21 Kretschmer 1935	6 mos	Difficult urination Swellings on under surface of penis Complete retention	Since birth	Inspection and palpation Aspiration with catheter Urethrogram	On left side of penoscrotal junction	Diverticulectomy	Cure	

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nual appears at least as a biennial. It is too much to expect that the news men will confine their attention only to all the news that is fit to print. It is too often apparent that fitness as such does not enter. The great need of the news agencies at the present time is the development of a desire for accuracy and for a conscience. These apparently harmless headlines are usually the cause for the movement of a caravan of helpless sufferers toward a forlorn hope. They go at no matter what sacrifice regardless of the distance. They pour out their life savings expecting the miracle which the papers have promised. The mass psychology buoys them up for a time. Then failure and despair. The excitement over the newspapers turn to other more sensational items. The failure which would also seem to have news value somehow never gets mention. The papers sometime could at least tell us where are the cures of yesterday which crowded all these poor people about the shrine of the discoverer.

The whole fault with this unwholesome cancer publicity is not entirely with the news agencies. The scientific investigators must also share a part of the blame. Any scientist who is conducting studies on any phase of the cancer problem should be unusually careful in what he publishes. The very anxiety of the news reporters will frequently cause them to misinterpret or to exaggerate the claims of the scientist. Scientific reports should clearly state that the experiments so far have been carried out only on animals. If the results seem to warrant a trial in human cancer, it should be easy to get some of the reputable medical schools or cancer research institutes to co-operate. This would in no way detract from the credit of the investigator. It would only tend to prove that the scientist had an honest belief in his remedy. It would indicate that he wished cor-

roboration from unbiased observers. This is the way that insulin was introduced to the medical profession by Dr. Banting. He did not insist that his remedy be kept secret. He did not start a procession of diabetics to Toronto. He quietly asked several of the leading medical school clinics to try out his agent against diabetes. This did not take any of the glory from the greatness of his discovery. It simply proved quickly that he was right. The same would be true in regard to any proposed treatment for cancer. When the scientific investigator gives an interview to the press before his discovery has been reported through regular medical channels, it lays him open to criticism on at least two counts. It shows a disregard for the other members of his profession who by right should know of new developments in medicine before the general public does. It is only fair that physicians who will be called upon to advise their patients should have a chance to think about the new treatment. It further more shows a naive simplicity on the part of the discoverer who thinks he can make such an announcement and escape the consequences. It makes the more cynical members of society look upon it as a desire to meet the consequences at any price—provided it is high enough. The cancer research worker must be patient, painstaking and deliberate. He must possess balanced judgment. He must subject his results to critical analysis. He must not let his enthusiasms bias his opinion. He must make his mind control his emotions. He must not jump to conclusions before he has tested and retested his results. When it is recalled how many apparently sane investigators have gone wrong on the cancer problem, it is evident that this field is full of pitfalls. Even the head men of cancer institutes have made mistakes in backing and promoting some of the seeming discov-

eries of their staff. The fault in such instances is in assuming more than the results have warranted. The repeated disappointments in cancer cures naturally have made authorities in this field very skeptical about new discoveries. They wish an opportunity to try them out before accepting them at face value. This is in a way unfortunate. It perhaps may make a slower acceptance of some fundamental discovery which may unlock the doors to progress. It also makes the tyro believe that these men are prejudiced against any new line of investigation. He consequently develops a martyr complex, which unhappily is fostered by the many agencies. The embryo scientist is pictured as a St. George fighting against the dragons of organized medicine.

In reality, the cancer authorities are simply trying to protect the public against exploitation. The appeal made by the new discovery attracts a large proportion of the public. The mass of the people accept it because of its emotional appeal, the intellectuals, because they are constantly on the alert for the new. The latter group are often more deceived than the former. They lack the proper background to make a reasonable estimate. The public, consequently, is also partly to blame for the uncontrolled publicity given to the cancer problem. If the public would react in some sensible way to these announcements instead of accepting them as reported, progress would be made. If the public would demand that the news agencies back their statements by the endorsement of recognized authorities in the field, or that the news of medical items should be handled through a publicity committee of the county medical society, if it could be made uncomfortable for those who broadcast false information, or if all the people would refuse "to be fooled all the time" by the papers but would receive their misinformation with jeers and ridicule, — there

might be a more honest attempt to get information of value rather than for its sensational qualities. The news of cancer would not in itself have malignant qualities as it does now when "it serves no useful purpose."

JOHN J. MORTON.

### APPLICATION OF FIXED TRACTION FOR TRANSPORTATION OF PATIENTS WITH FRACTURES

THE United States census reports show that there were 36,000 fatalities from automobile accidents in 1935. It is estimated from reliable figures that there occurred one million fractures during this period from the same cause.

Sir Anthony Bowlby, head of the medical department of the British Expeditionary Forces during the early part of the World War, estimated that the mortality from compound fractures after the adoption of fixed traction in transportation was reduced from 80 per cent to 20 per cent. The stretcher bearer and the doughboy were trained to apply fixed traction on the battle field. It is now more than 17 years since the World War and we are not giving our ever increasing number of sufferers from high speed locomotion the same chance of life and health that was given our soldiers. During that time many more Americans have been injured or accidentally killed than in all the wars in which the United States has engaged.

It has been argued that the layman should not be taught to apply a splint for aid in transportation because of the implied entrance of the laity into the medical field. Nevertheless, no one would argue that a layman should not attempt artificial respiration in a case of submersion, or that a layman should not apply a tourniquet to prevent death from hemorrhage, provided a doctor were not available. Doctors are rarely present at the time

of an automobile accident. If by the application of a Keller Blake splint to the lower extremity or a Murray Jones splint to the upper extremity jacking of the fractured bones with resultant shock and delayed union can be prevented and the patient transported in safety to the nearest doctor or hospital for treatment a great step in advance will be made.

By medical and lay propaganda in many cities and states the Committee on Fractures of the American College of Surgeons through its regional groups has stimulated interest in the safe transportation of fractures and definite improvement is noted in many localities. Ambulances in general are manned by doctors, fire or police departments or morticians according to the section of the country. Instruction is being given to these various groups and many ambulances are now equipped with traction splints but unfortunately only a comparatively small proportion of them has been reached.

The American Red Cross has been interested for a long time in the problem of emergency first aid along automobile highways. Instruction in the application of the Keller Blake half ring splint for fractures of the lower extremity has been incorporated in the latest edition of its book on first aid. It is now establishing emergency first aid stations along many of the main highways. Traction splints are a requirement in the equipment of these stations and their attendants are being trained in the application of immediate traction. The Committee on Fractures of the American College of Surgeons is co-operating with the American Red Cross by asking the

members of its Regional Fracture Committees to assist in the necessary instruction to be given the attendants. There are at present 238 stations fully equipped and operating and 1440 are promised to be opened within the next 6 months. These stations are being started in 34 states.

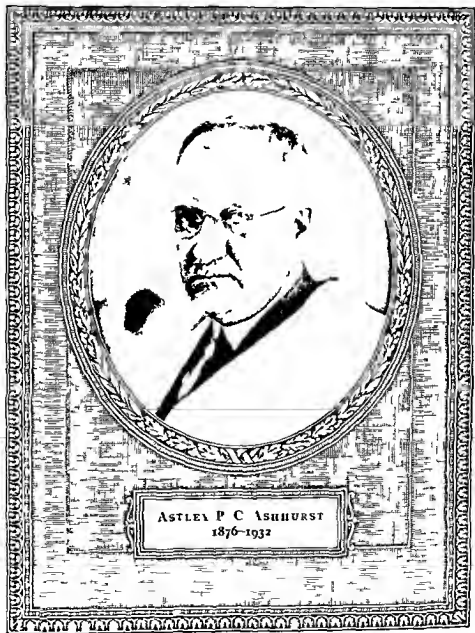
The officials of the Boy Scout organization have taken up very actively the problem of transportation of the injured and in all the camps throughout the country the Boy Scouts are being trained in the application of fixed traction. The leaders of the Girl Scouts have indicated their willingness that similar instruction be furnished the girls.

The American College of Surgeons having entered into this move to protect the traveling public has assumed certain obligations. With the large amount of lay propaganda that is being disseminated by the American Red Cross, the Boy Scouts and the Girl Scouts it is necessary that surgeons throughout the country should be themselves thoroughly informed of the method of applying fixed traction and should be willing to offer their services to aid these organizations should they be so requested. If these requests come from the American Red Cross it is advisable to follow the method described in the Red Cross book on first aid. There can be no question that if transportation of patients suffering from fractures can be so improved injury incurred during transportation will not be added to the original injury, the saving of life and the decrease in the period of hospitalization will be of great economic benefit to mankind.

FREDERIC W. BANCROFT  
Chairman Committee on Fractures  
American College of Surgeons







ASTLEY P C ASHHURST  
1876-1932

# MASTER SURGEONS OF AMERICA

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## ASTLEY PASTON COOPER ASHHURST

FROM Colonial days Philadelphia has contributed more than its share to the progress of medicine. Soon after the middle of the eighteenth century a group of young Americans returned from Edinburgh imbued with the spirit of that school. It was not long before Morgan and Shippen started the first medical school in Philadelphia, and were soon joined by Kuhn and Rush. Since that time there has been a steady stream of men whose writings and teachings have spread throughout the land, the results of their own searchings after truth. Bond and Barton, Wistar and Physick, the Hares and Woods, the Hodges and Penroses, Agnew and Leidy, the Peppers and Ashhursts.

Astley Ashhurst early appreciated the responsibilities he had inherited from his father, John Ashhurst, Jr., professor of surgery at the school Morgan had started. His devotion to this profession and its ideals was the dominating influence in his whole life. Except for his war service, his entire career was spent in Philadelphia. He was born there August 21, 1876, his mother being Sarah Stokes Wayne Ashhurst. He prepared at the Forsyth School, now the Episcopal Academy, a private college preparatory school located in Philadelphia, and entered the University of Pennsylvania from there, receiving his degree of Bachelor of Arts in 1896 and his Doctor of Medicine in 1900. His classmates always remembered him as taking prizes in Latin and Greek and in taking senior honors in the Academic Department, and he was elected to membership in the Philomathean Society, the Phi Beta Kappa and the Sigma Xi fraternities, and graduated the first man in the senior class of the medical school.

After leaving the medical school he served an internship from 1900 to 1901 at the Children's Hospital, and from 1901 to 1904 at the Episcopal Hospital. Following his internships he served an apprenticeship in the dispensaries of the Episcopal, Orthopedic, Children's, German (now Lankenau), and the Pennsylvania Hospitals until 1913, when he was elected surgeon to the Orthopedic Department and associate surgeon to the Surgical Department of the Episcopal Hospital. In 1914 he was appointed surgeon to the Orthopedic Hospital and in 1915 he was promoted to the position of surgeon at the Episcopal Hospital. His training as prosector to Dr. G. G. Davis, professor of applied anatomy at the Medical School of the University of Pennsylvania, gave him a knowledge of

surgical anatomy which not only influenced his operative work but hallmarked all his contributions to surgical literature. For 19 years 1911 to 1930 he was an instructor in surgery at the University of Pennsylvania teaching operative surgery on the cadaver. From 1930 until his resignation in May 1932 he was professor of clinical surgery at his Alma Mater.

From the establishment of teaching in the University's Graduate School of Medicine in 1918 Dr Ashhurst evinced great interest in the ideas and work of the School. In 1920 he became an associate in surgery in the School; in 1921 an associate professor of surgery; and in 1923 a professor of clinical surgery. The latter post he retained until his death in 1932—although inactive from illness toward the end. His teaching of clinical surgery to the graduate students of surgery especially in the Episcopal Hospital of Philadelphia exemplified those qualities of conscientiousness, erudition and technical perfection which were his admirable characteristics.

His wide knowledge of surgical literature and his mastery of the fundamentals of surgery together with his interest in teaching made his lectures and quizzes popular with the students. The student's first impression of him was usually unfavorable. His hesitating speech which was the result of stuttering in early manhood together with his hypercritical respect for the truth were causes of his being at first misunderstood but his sterling character and the justice of his criticism not only of others but of himself were soon appreciated by the students and explains his popularity with them.

As a surgeon he was methodical in the superlative degree says Dr Crossan one of his associates and insisted upon performing every detail of the operation himself including the application of the bandages. Neither brilliancy nor speed in operating was attempted by him and he seemed to abhor the spectacular. He was just as meticulous of the pre-operative and postoperative care of his patients as in his operative technique and he would never accept the opinion of any one without himself consulting the evidence making his own physical examination examining the X-ray films and studying the gross macroscopical preparation of the tissues.

He was proud of being a general surgeon and with such wide and varied training as he had received he was well fitted for such a broad field. Though tempted after the death of Dr G. G. Davis to limit himself to orthopedic surgery for which he had such an unusual training he said that surgery of the bones and joints belonged to the general surgeon and that such a special field was too small to occupy the full time of a well trained surgeon. He was trained also in gynecology. For several years he did the neurosurgery at the Orthopedic Hospital.

Outside of Philadelphia as one would expect he was probably best known as an author. His scientific articles were not only clear and simple but uniformly accurate and all of his contributions to surgical literature reflect his scholarly

attainments As one would expect from his clinical work, he never accepted the statements of others in literature, but always ran them down to their source and frequently embarrassed his colleagues by his discovery of inaccuracies One wonders where he found time for all this work, for between the years 1902 and 1920 he wrote 82 magazine articles, was co-author in 10 others, wrote numerous book reviews, edited 2 volumes of the Episcopal Hospital Reports, was a co-author of 2 textbooks (*Enlargement of the Prostate*, with Dr John B Deaver, and *Surgery of the Upper Abdomen*, with Dr John B Deaver) and published the first edition of his book *Surgery, Principles and Practice*, and the "Gross Prize" essay "An Anatomical and Surgical Study of Fractures of the Lower End of the Humerus"

He was a very active member of the Philadelphia Academy of Surgery and was rarely absent from its meetings His presence was not passive in any sense, but always active up to the time of his illness This activity consisted not only in his own presentations, but in a critical discussion of nearly every paper He felt it the duty of every Fellow to prepare a discussion of the subjects presented at the meeting His knowledge of the literature and careful preparation of his discussions stirred his fellow members to efforts usually beyond their inclinations They all knew that he would be at the meeting and that he would make as great if not greater preparations for his discussion than they had in their presentation His value to the Philadelphia Academy of Surgery cannot be overestimated He delivered the annual address in 1910 and served as president in 1928 and 1929, and received the Samuel D Gross Prize in 1910 for "An Anatomical Study of Fractures of the Lower End of the Humerus"

He was vitally interested in the College of Physicians and could be found in the building at some time during each day reviewing literature or discharging his duties as honorary librarian, a position he held from January 9, 1928, to the time of his death

He was elected a Fellow of the American Surgical Association in 1913, and he brought to that association the same unique qualities which he exhibited in the Philadelphia Academy of Surgery Astley P C Ashhurst could not be other than Astley P C Ashhurst—whether it was in Philadelphia, in the American Surgical Association, the Interurban Surgical Society, the Society of Clinical Surgery, the Society of Military Surgeons, the International Society of Surgeons, Association de Française de Chirurgie, the Academy of Natural Sciences, or the Historical Society of Pennsylvania, he was the same sterling scholarly character in search of medical truth

His sense of duty and his belief in the obligation of service sent him to the first Officers' Training Camp organized at Plattsburg, in 1916 With America's entry into the World War he organized the Episcopal Hospital Base Unit 34 and was its first medical director He was sent to France with this Unit December 15, 1917, and returned to America in 1919 In France he served at the front with

the French and the Americans and after the Armistice was appointed as a consultant to the Hospital Center at Savenay. Upon returning home he was appointed chief of the surgical service at the Walter Reed Hospital where he served until the time of his discharge from the Army April 16 1919. He entered the Army as a first lieutenant and was discharged as a colonel. He received a citation for exceptionally meritorious and conspicuous service with Base Hospital 34.

As a man he was almost a crusader for honesty and truth. With Ashhurst there was not such thing as a white lie or a gray lie. Truth permitted of no comparison and it was either a truth or a falsehood. Few of us have not winced at his criticisms and book reviews which were rarely sought by writers or publishers because he insisted on recording what he believed to be true. His probity won him great respect even though it did not make him popular. His was a life devoted to surgery. He had no hobbies and his relaxation was study. Eventually the long hours of clinical work and study began to show their effects. In 1929 at the early age of 52 he began to suffer from dizzy spells and in the latter part of May 1930 while driving his car on the Roosevelt Boulevard he had his first attack of cerebral thrombosis and crashed into a tree. He was able however after getting out of the wreck to take a picture of it and make his way to his office by trolley and bus. Several hours after he reached home it was noticed that he had a left hemiplegia. After months of rest he entirely recovered the use of his hand and leg and gradually returned to operating and teaching. However in the latter part of August 1932 he had a second attack of thrombosis from which he rallied but a third attack on September 16 1932 resulted in his death 3 days later. To those who knew him intimately he never made the slightest complaint or lament of his misfortune. When asked if he did not know that he was carrying high blood pressure he replied "Yes but what is there to do about it?"

On July 16 1930 he married Anna Campbell during his remaining days his constant companion and devoted attendant. His wife and daughter survive him.

Ashhurst was not an ordinary man. He was rather tall but stooped shouldered strong but gentle never hurried but constantly active apparently slow but accomplishing much. Seemingly a crabbed bachelor but with a warm heart and understanding sympathy a caustic but fair critic dogmatic but open minded not widely popular but much beloved a diligent student all his days and a teacher of sound surgery. For over 30 years he met his inherited responsibilities and carried on the Philadelphia tradition. He contributed much and will be sorely missed by his patients his students and his friends.

WALTER ESTELL LEE  
WILLIAM DARRACH

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

AS a result no doubt of the disordered political and economic conditions throughout the world, there has been a dearth of original and enlightening radiological contributions in the field of diagnosis.

As in the former volumes of the *Year Book of Radiology*,<sup>1</sup> the authors again present concise, yet adequate reviews of articles which have appeared in medical literature during the preceding year. The material has not been selected from the radiological journals alone, but from the many periodicals covering the field of medicine and surgery. Many articles which appeared in European literature have been used. Barring the inversion of two or three, the 454 illustrations are well reproduced.

The first 303 pages of the volume are devoted to the field of radiological diagnosis. Although there have been no spectacular new developments, the articles have a quality which points to a high and efficient plane of diagnosis. Arteriography has become a helpful diagnostic procedure. More accurate roentgenographic study of the petrous bone has proved to be very valuable.

Economic conditions have interfered considerably in the field of cancer research and investigation. While no startling new results have been reported, the work in the United States has been carried on with renewed vigor. The field of radiotherapeutics covers 195 pages of the volume. Included in this section is not only material on radiotherapeutics but numerous articles on other phases of the cancer problem such as etiology. Although there is a definite tendency toward increased voltage, its value has not yet been answered by experience. The same statement may be made concerning the efficacy of the big radium pack rather than the smaller unit. The protracted method of treatment along the lines advocated by Coutard has definitely proved its value, particularly in carcinoma of the upper respiratory tract. The value of radiation in the treatment of various benign conditions, such as infections, is gaining much favor.

The radiologist will find the volume very valuable as a handy source of reference. The satisfactory manner of presenting the material is commended and the volume is recommended to the busy physician not able to read the vast amount of material covered.

The 1935 volume<sup>2</sup> provides the radiologist with a handy source of reference to the important

radiologic literature of the year. The volume is larger and contains more illustrations than the 1934 review. All phases of radiology, both diagnostic and therapeutic, have been covered. As in former volumes, the short, concise editorial comments concerning the articles which are abstracted enhance their value.

Part I, covering 338 pages, is devoted to the field of radiological diagnosis. Recent work in the roentgen study of the nervous system has been rather extensively abstracted. The value of thorotrast in the diagnosis of inflammatory foci in bones is of interest. Technical procedures such as "polysography," tomography, and kymography are gaining more attention. Other works of interest include various methods of localization of foreign bodies in the eye, breast radiography, serial bronchography, more accurate small intestine studies demonstrating inflammatory lesions and Meckel's diverticulum, refinements in cholecystography, diagnosis of placenta praevia by cystographic studies, pelvimetry and cephalometry and the non-surgical reduction of intussusception under fluoroscopic control. Especially timely, and of great interest to the radiologist, is the increasing tendency of widespread practice of medicine on the part of the hospitals. Articles dealing with industrial hazards, the medicolegal aspects of silicosis, and the economic problems of radiology are pertinent.

The field of radiotherapeutics is covered in Part II, consisting of 237 pages. The death rate due to cancer is increasing. Research work on the causative factors of cancer has been carried on with interest. Surgery and irradiation remain the most effective weapons at our disposal for combating the disease.

Advancements have consisted of attempts toward perfection of irradiation methods based on more extensive experience. The question of whether super X-rays are superior to those generated by the 200 kilovolt apparatus or the large radium pack, has not been settled. The various safe-acting safeguards of X-ray apparatus has been an important development. The shift to radiation rather than surgery in the treatment of cancer of the cervix has been an important advance. Recent work on the treatment of cancer cases with cobra venom showed it to be ineffective and to have no value in relieving pain. Radiation has gained increasing favor in the field of

<sup>1</sup>THE 1934 YEAR BOOK OF RADIOLOGY. Diagnosis. Edited by Charles A. Waters, M.D., Therapeutics. Edited by Ira I. Kaplan, B.Sc., M.D. Chicago: The Year Book Publishers, Inc., 1934.

<sup>2</sup>THE 1935 YEAR BOOK OF RADIOLOGY. Diagnosis. Edited by Charles A. Waters, M.D., Associate editor. Whitmer B. Fisor, M.D., Therapeutics. Edited by Ira I. Kaplan, B.Sc., M.D. Chicago: The Year Book Publishers, Inc., 1935.

benign conditions. It has proved to be of real value in the various inflammatory conditions as well as in cases of endocrine disturbances.

The volume should not only be a valuable addition to the library of the radiologist but to the busy physician or surgeon who does not have time to read the vast amount of material covered.

EARL E. BARTLE.

**ANOTHER** Oxford medical monograph<sup>1</sup> embraces in 170 pages a careful review of the literature and a correlation of the now accepted facts. The reference material is worthy of especial comment. The chapter on physiological and pathological considerations is indeed worthy of note. The indications and methods for administering oxygen by different routes in different diseases has been considered on an obviously unbiased basis. Illustrations and clinical problems showing defects as well as success round out the material so as to render it very useful to the general practitioner.

The manner and methods compare favorably with those in use in America. American references and equipment play a prominent role in this volume. The authors are enthusiastic for the proper use of oxygen as are all who are familiar with its clinical application. They offer a hope for the early general adoption of an oxygen service which may be conducted on a voluntary basis and available to all alike. An excellent book bringing up to date the known facts relative to oxygen and carbon dioxide therapy.

M. HERBERT BARKER.

**THE** book<sup>2</sup> entitled *Apparatus and Technique for Roentgenography of the Chest* by Weyl and Warren is a highly technical work comprising material dealing with the physical phenomena underlying roentgenography in general, the available roentgenographic equipment and its limitations, the practical application of such equipment for chest roentgenography and methods of measurement and standardization of roentgenographic apparatus and technique. The authenticity of the work is attested not only by the institution from which it emanates but also by the stamp of approval given by such men as Dr. Maurice McI. Hedran and Drs. Chamberlain and Pancoast.

There are doubtless numerous physicians who have become the possessors of roentgenological equipment whose major qualification for operating the apparatus consists in their possession of it. These physicians usually leave the actual technical operation of their equipment to technical assistants whose training has usually been skimpy and all too brief and their preliminary groundwork so lacking in mathematical and physical instruction they would

find the mastery of this work rather tough going. Most radiological specialists are quite familiar with these principles and practice them in their current medical activities. Other physicians who essay the roentgenological examination of the chest would do well to study this excellent manual.

JAMES T. CASE.

**IN** a small book of approximately 170 pages divided into ten chapters and an appendix Tucker discusses injuries and their treatment. The appendix is devoted to the illustration of apparatus for the application of diathermy and radiant heat.

Judging from the preface and from the type of illustration used throughout the book, one concludes that the book is written principally from an experience based on athletic injuries. Soft tissue (muscle tendon ligament) injuries are dealt with for the most part and bone nerve and visceral injuries are mentioned only in passing. In this regard the title is somewhat misleading. The book can hardly be regarded as a thorough work because so many subjects are touched upon in such a limited number of pages.

In general it would seem that the book would be more valuable in the library of an athletic trainer or a physiotherapist than in that of a surgeon.

JAMES E. STACK.

**OUR** ideas pertaining to tuberculosis and particularly as regards its treatment have been in such a stage of flux during the past 10 years that a work on this subject at this time compiled from the experience of thirty-four specialists in its various phases comes to the medical profession at an opportune time.

*Clinical Tuberculosis*<sup>3</sup> is much more comprehensive than its title would infer. The two volumes contain 48 chapters and in each of these the disease is attacked from a different aspect with ample bibliographies at the end of each chapter. Epidemiology pathology physiology classification physical diagnosis X-ray interpretation symptomatology medical treatment surgical collapse extrapulmonary tuberculosis complications etc. are covered in excellent detail. One might be carried away by the enthusiasm of Coryllos in his policy of delay while acclaiming the virtue of surgical apical collapse. There are still not a few who might question his early policy of waiting and not applying more simple surgical procedures while endeavoring to ascertain the character of the disease. His ideas are rather at variance with recent teaching which stresses early diagnosis and the prompt employment of less formidable procedures.

On the other hand Hedblom leaves us a well

<sup>1</sup> O. E. & C. 220 D. 10 THE APP. By A. J. Campbell M. D., D. S. (Edin.), and E. F. Foul. M. A. D. M. (Ox.) F.R.C.P. (Lo d.) F. reward 1 y 5 Leonard Hill F.R.S. Lo do Oxford University Press 934

<sup>2</sup> O. E. & C. 220 D. 10 THE APP. By A. J. Campbell M. D., D. S. (Edin.), and E. F. Foul. M. A. D. M. (Ox.) F.R.C.P. (Lo d.) F. reward 1 y 5 Leonard Hill F.R.S. Lo do Oxford University Press 934

<sup>3</sup> O. E. & C. 220 D. 10 THE APP. By A. J. Campbell M. D., D. S. (Edin.), and E. F. Foul. M. A. D. M. (Ox.) F.R.C.P. (Lo d.) F. reward 1 y 5 Leonard Hill F.R.S. Lo do Oxford University Press 934

<sup>1</sup> SERIES NO. T. T. R. K. E. M. T. By W. E. M. Tucker M. A. B. Ch. (Cambr.) F.R.C.S. (E. G.) New York & Oxford University Press 935

<sup>2</sup> CLINICAL T. B. CYCLOP. Ed. d. b. Be. jani. Goldie. E. M. D. F. A. C. P. F. A. P. H. A. V. 1. 1. and Philadelphia F. A. D. vs. Co 35



balanced surgical viewpoint with due recognition of the value of phrenic surgery and pneumothorax

There is necessarily much repetition and also contradiction in not a few instances. The latter is rather an asset for it presents the views of more than one author and leaves questions open for discussion. One cannot help but be impressed by the practical application of the writings of these thirty-four collaborators. It is perfectly evident that they are thoroughly familiar with the everyday problems presented to medical men specializing in this field of medicine.

The two volumes are well illustrated with over 640 halftone and line drawings and 9 full-page color plates.

While there is much that is superfluous and some unevenness in the quality of the work, still the chapters are all uniformly good and one can absorb useful bits of information from each and every chapter. The work is well organized and complete and correlates our knowledge of tuberculosis up to the present moment. These two volumes should be of interest to all students of medicine but particularly will they be of value to those specializing in tuberculosis.

The editor and his contributors should be highly complimented on their excellent and very thorough presentation and their work should take a high place in our literature dealing with tuberculosis.

JOHN W TOWEY

A GREATLY neglected subject has been excellently dealt with by Jameson in his monograph *Gynecological and Obstetrical Tuberculosis*.<sup>1</sup> Written as it is, by one who is well qualified both from the viewpoint of the phthisiologist and the gynecologist it fills a definite void in modern gynecological literature. The author has gathered together the complete literature on the subject and, in addition, has added his own studies, which were carried out at Saranac Lake, as well as his experiences in the autopsy room and at the bedside in the various sanatoria of this region. This material he has correlated from all of the various angles of the subject into a most comprehensive and readable work. For the first time, the modern knowledge of the physiology, diagnosis, and treatment of tuberculosis of the pelvic organs and the ever present problem of tuberculosis and pregnancy are adequately handled in one monograph. The book is most highly recommended.

RALPH A REIS

IN *The Principles and Practice of Surgical Nursing*<sup>2</sup> an effort is made by the author to present the nurse with a working knowledge of the diseases that the surgeon meets most frequently. It is believed that by obtaining this information the nurse will

become a better assistant to the surgeon and not one who merely follows instructions. The nurse is expected to be on the lookout for unusual signs and symptoms, to observe the effect of drugs and procedures, and to use her own initiative in the event of a crisis.

There are chapters on inflammation, wounds, burns, ulcers and gangrene, tumors, anesthesia, and pre-operative and postoperative care of surgical patients.

Surgery of the various regions of the body is discussed as are fractures, diseases of the bones and joints, deformities, and the application of physical therapy to surgery. A brief description of the principles of nursing that may be of particular interest in handling each type of surgery, is given, but the actual technique of nursing and nursing procedure are not included in the book.

This work is an effort to satisfy the authors' belief that nurses in the better schools are as well grounded in the sciences fundamental to medicine as were the medical students of 10 years ago and that the nurses are eager for accurate knowledge pertaining to the field of surgery.

The inclusion of diagnostic methods with the technique of operative and manipulative treatment of surgical conditions, the dosage of drugs in many instances and the descriptions of such operations, with drawings, as division of the sensory root of the trifacial nerve, operation for aneurism, radical removal of the breast, and certain minor procedures done by a general practitioner might lead one to question the choice of teaching material for other than medical students.

G L McWHORTER.

THE second edition of Zondek's valuable and extensive monograph<sup>3</sup> is introduced by a short essay on fallacious methods of hormone research that might well be applied to general scientific medical investigations,—"Verlasst man sich also nur auf die klinische—an Fehlerquellen reiche—Beobachtung, so kann der unkritische spielend Theorien machen und seiner Phantasie weiten Spielraum geben." The material presented is, thus, mainly a record of physiological research. An exhaustive review is given of the assay, source, preparation, biological action, occurrence in the male, fate, and hormone interrelations of estrogenic substances. The pituitary gonadotropic hormones are then taken up in the same way. The interplay of the pituitary and gonad is then thoroughly studied. Clinical determination of folliculin and prolactin in the blood and urine is described. Polyhormonal menstrual disorders are discussed. The occurrence of pituitary follicle stimulating hormone is given and its excretion in male and female genital malignancy described. The clinical use of estrogenic and pituitary substances is covered. Reviews of the hormone diagnosis of pregnancy and Zondek's studies of inter-

<sup>1</sup> GYNECOLOGICAL AND OBSTETRICAL TUBERCULOSIS. By Edwin M Jameson. B.S., M.D. Philadelphia: Lea & Febiger, 1935.

<sup>2</sup> THE PRINCIPLES AND PRACTICE OF SURGICAL NURSING. By Charles D Lockwood, A.B., M.D., F.A.C.S., and John A. Wolfer, M.D., F.A.C.S. In collaboration with Mildred E. Newton, B.S., R.N. 2d rev. ed. New York: The Macmillan Co., 1935.

<sup>3</sup> HORMONE DES OVARIUMS UND DES HYPOPHYSENORDERLAPPENS. UNTERSUCHUNGEN ZUR BIOLOGIE UND KLINIK DER WEIBLICHEN GENITAL FUNKTION. By Dr. Bernhard Zondek. 2d ed. ed. Wien: Julius Springer, 1935.



# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE PATHOLOGICAL PHYSIOLOGY OF STONE IN THE COMMON BILE DUCT

CLINICAL AND SURGICAL SIGNIFICANCE<sup>1</sup>

WALTMAN WALTERS, M D, F A C S, ROCHESTER, MINNESOTA  
Division of Surgery, The Mayo Clinic

ON a previous occasion I have discussed the general topic of obstructive jaundice (4, 5, 6), therefore, I shall here limit myself to a discussion of stone in the common bile duct, referring particularly to that group of cases in which the characteristic symptomatology associated with stones of the common duct is lacking in some details or even in its entirety, or in which the presence of the stones is an unexpected finding at the time of operation on the gall bladder. Obviously, failure to recognize the presence of stones in the common duct might be followed by serious postoperative disturbances and most certainly such failure would lead to further distressing symptoms and consequently to the assumption that cholecystectomy had been unsuccessful. It is my belief that many of the so called cases of unsuccessful cholecystectomy are attributable to the presence of stones of the common duct which have been overlooked.

Let us assume for argument only that in all operations on the gall bladder the common duct should be opened and explored. This would enable one to determine the presence or absence of stones in the common and hepatic ducts, and to remove, let us say, all stones present there. However, the common bile duct is normally the size of a goose quill and routine incision into, and exploration of

the interior of, the duct would prolong the operation and increase the operative risk, moreover, there would be likelihood of injury to the duct because of its small size. Stating this in other words to emphasize the point, which I think is related to one of the most important principles underlying treatment of lesions of the biliary tract, stone or other obstruction of the common bile duct is always followed either by dilatation of the duct or by thickening of its wall, therefore, a common duct which has undergone such changes always should be opened and explored. To this some may think that the phrase, "if the condition of the patient permits," should be added but with this I cannot agree, for, provided the condition of the patient is such as to permit any surgical procedure on the biliary tract, such a procedure is not complete, and serious postoperative consequences are likely to develop, if one fails to recognize the presence of, and to remove, a stone or stones from the common duct. Having thus referred to the reason for opening the common duct, it is assumed that the stones will be completely removed and that the sphincter will be gradually dilated by the passage through it, into the duodenum, of a series of exploring scopes, gradually progressing from a small one to larger ones. Thus, if small fragments of stone should remain within the hepatic ducts, their

<sup>1</sup>Read before the meeting of the Seattle Surgical Society January 31 to February 1, 1936 at Seattle, Washington and also before the meeting of the Chicago Surgical Society February 7, 1936 at Chicago, Illinois

spontaneous passage through the duct and into the duodenum would be facilitated.

In most cases of disease of the biliary tract the nature of the patient's symptoms has so impressed the physician or the patient themselves with the fact that a surgical lesion of the biliary tract is present that surgical treatment is advised usually is eagerly accepted and operative procedure on the gall bladder is carried out. It is at the time of operations on the gall bladder that recognition of enlargement of the common duct enables the surgeon to carry out exploration and to remove stones from the common or hepatic ducts. There is however a large group of patients who have lesions both of the gall bladder and of the common bile duct in examination of whom because of the mildness of the symptoms or because of the absence of jaundice the possibility of a stone of the common duct does not readily come to mind. For simplicity of description it would seem that such patients might be divided into several groups.

The first group might be considered to include those patients who have silent stones of the common duct. Presence of the stones is unsuspected until the common duct has been opened. There may have been no subjective or objective evidence of jaundice at any time and intermittent hepatic fever may have been completely lacking. I have operated in many such cases of which the following will serve as an example.

January 14, 1936 I operated on a married woman whose symptoms of disease of the biliary tract were mild. She had had a few attacks of mild biliary colic. She never had had jaundice, chills or fever. Although roentgenograms of the gall bladder gave evidence of the presence of stones, the patient only reluctantly consented to be operated on.

At the time the operation was performed not only was the gall bladder found to be completely filled with stones but the common bile duct was twice normal size and when opened and explored was found to contain 900 small stones similar to those which were in the gall bladder (Fig. 1). Three or four of these stones were obtained from the intrahepatic duct but only after the duct had been searched three or four times with exploring scoops were they brought forth. Because the number of stones was large they were palpated within the duct. The enlargement of the duct would have served as an indication for opening the duct even had the stone not been palpable.

Reference has been made in this case to the fact that roentgenological examination of the gall bladder gave evidence of stones; this finding deserves further elaboration. It is my impression that in general too much dependence is placed on the roentgenographic report of the condition of the gall bladder and too little dependence on the clinical history of the patient who has disease of the biliary tract. On innumerable occasions I have removed diseased gall bladders containing stones from patients who presented rather typical clinical histories of disease of the biliary tract but to whom someone previously had denied operation because the gall bladder had filled and emptied normally and shadows of a stone or stones had failed to show in the cholecystogram. Recently 13 sizeable faceted stones were removed from the common bile duct of a patient whose cholecystogram revealed a normally functioning gall bladder (Fig. 2). Moreover the patient's only symptom of disease of the biliary tract was intermittent fever without jaundice. And it is this patient whom we can use as an example of the second group whose only symptom of stone of the common duct is intermittent fever which may or may not be associated with jaundice. In cases in which there is intermittent fever jaundice being absent the utmost care must be taken to exclude causes of intermittent fever other than obstruction by stone. I shall not discuss such causes at this time other than to say that in the week in which this patient was operated on operation was performed on 7 other patients who had intermittent fevers. In one of these 7 cases the fever was the result of a right psoas abscess and in the other it was attributable to invasion of the inferior vena cava by a large malignant tumor of the right suprarenal gland.

A patient of the third group has in the ampulla of the common duct a single stone which may produce attacks of biliary colic without jaundice. Such patients frequently have an irregular type of epigastric distress associated with pylorospasm; the distress is characterized by eructation of gas and vomiting with resulting loss of weight; the symptoms of pylorospasm may be paramount and

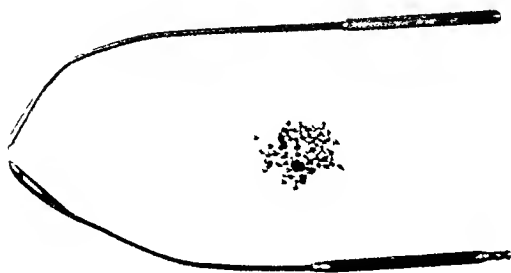


Fig 1 Stones removed from common and hepatic ducts, the patient did not have jaundice

colic, absent. That such a syndrome is the result of the presence of a stone in the ampulla of the common duct frequently is not recognized because of the absence of jaundice.

#### BILIARY CIRRHOSIS ASSOCIATED WITH STONES IN THE COMMON DUCT

On several occasions operation has been performed on elderly patients, 2 recently, 1, 75 years of age, the other, aged 70 years, who had marked biliary cirrhosis and some ascites, in each of these cases a large stone was present in the common duct and was easily removed. The patients recovered from the operations and the pain caused by the stone of the common duct was relieved.

I refer to those cases because in each of them the presence of the biliary cirrhosis and the age of the patient gave rise to a great deal of speculation as to whether the patient would be able to recover from an operative procedure on the biliary tract. I refer to them also because they demonstrate the ability of deeply jaundiced patients who have biliary cirrhosis to recover from surgical procedures even though they are of advanced age. They direct attention, furthermore, to the fact that patients who have jaundice and enlarged livers may be denied operation on the assumption that the entire symptom complex is the result of hepatic cirrhosis, when actually the trouble is that there is a stone in the common duct, and the cirrhosis is secondary to the stone. This condition is more likely to be found, of course, if the patient has episodes of biliary colic or intermittent attacks of fever, but it

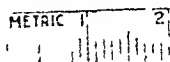


Fig 2 Large stones removed from the common and hepatic ducts, the patient had intermittent hepatic fever without jaundice

should always be remembered that there is possibility that one or more stones may be present in the common bile duct of a patient who has jaundice even though there has been no evidence of the characteristic biliary colic. The presence of stones in the common duct can be determined in many such cases only if the patient is given the benefit of abdominal exploration. Moynihan put it well when he said "No one living is infallible in the differential diagnosis of obstructive jaundice. The diagnosis is always so difficult, and the chance of a life saved so important, that, however positive the evidence of malignancy may be, I now advise operation in all cases." Quoted from Moynihan further "It is impossible for the most astute clinician or the most skillful pathologist to discover by physical signs, from the anamnesis or from the chemical examination of urine and feces, whether a simple or a cancerous disease is present. He may shrewdly guess, but a guess is a poor peg on which to hang a man's life. All cases of obstructive jaundice should be treated by operation."

#### THE PREVENTION OF FORMATION OF STONES IN THE COMMON DUCT

Any discussion of the surgical treatment of stones of the common duct should not be terminated without discussing methods of preventing their formation. It can be assumed that hard, faceted stones reach the com-

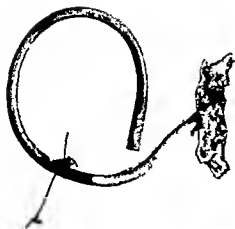


Fig 3 a l f t t b e r e m e d f r o m c o m m b i l e d t f  
p l e n t i t h h m l y c i e r h o h a d r e c r r g b t  
p i g m t s t o n s l i g f m r s e o f h m l y s f  
e r y t h o c y t e b d e c a e i n u o f d t l m l f l l g



t h e r e m a l f s t e s a n d l o s w i t h d r a n a g e ( a t t h e  
t i m e f p e a t i n t h e d c i w a s 2 5 t i m e s d i a m 1 2  
a n d s f d t o b p c k e d f l l f m s h y l u l p g m a t  
s t s )

bile duct by passage from the gall bladder through the cystic duct. Stones formed within the common or hepatic bile ducts are usually soft granular and putty like and depending on their constituents and the duration of their presence may or may not assume spherical or ovoid shapes and various degrees of hardness. In a case of hemolytic icterus in which operation recently was performed bile pigment stones had continued to reform in the common bile duct as a result of repeated hemolysis of large quantities of erythrocytes. After removal of the spleen and clearance of the extrahepatic bile ducts of the stony material stones did not reform (Fig 3).

On many occasions there have been removed from the ampulla faceted stones which were apparently the original cause of the obstruction of the common duct and above them in the common bile duct were multiple bile pigment stones which it was assumed had formed within the common or hepatic ducts as the result of the biliary obstruction. It would seem of value therefore in determining the etiology of stones of the common duct to carry out chemical analysis of the stone in all cases and in addition to study the bacterial flora of bile obtained from the

common duct when it is opened for exploration. Such methods of study have been employed routinely at the Mayo Clinic for some time. It seems to me that knowledge of the type of biliary infection and of the constituents of the stones formed secondarily in the common bile duct when considered together with the certainty that biliary obstruction has been completely relieved assumes considerable significance in the effort to reduce the incidence of recurrence of stones of the common duct.

The problem here is not unlike that presented by renal calculi. Great advances have been made in solution of the problem of recurrent formation of renal calculi by correction of metabolic disturbances and by marked acidification of the urine by medicinal and dietary measures. Cultural studies of the urine have been made and the particular organism present has been isolated. Studies of the effects of high degrees of acidity and acidosis obtained by the ketogenic diet have shown that most bacillary infections of the urinary tract can be destroyed while most coccal urinary infections have responded in a surprising fashion to intravenous injection of certain arsenical preparations. The bacterial

flora of the biliary tract is not unlike that of the urinary tract. In a group of 50 cases in which the common duct was opened and explored because of enlargement of the duct, the result either of stone in the common duct or of pancreatitis, the predominating organism was a gram-negative bacillus of the colon group. These gram-negative bacilli may occur alone or associated with both streptococci or staphylococci, or the streptococci or staphylococci may be present without bacillary infection. It is much more difficult to change the reaction of bile than that of urine but, as a working hypothesis, it could be assumed that, as the halogenated phthaleins are excreted in part through the biliary tract sufficiently well to outline the gall bladder, these substances might serve as a base to which might be added an antiseptic radical which would markedly affect the bacterial flora of bile. This problem is being worked on at the present and in addition the effects of changes in metabolism on the constituents and bacteriology of the bile are being studied.

Just as in the urinary tract, so in the biliary tract, control of infection is of importance but adequate relief of obstruction is paramount. Therefore, studies have been carried out on the physiology of the common bile duct by injecting into it a substance, brominol, which is opaque to roentgen rays. When the common bile duct is opened and explored, temporary drainage is instituted with a T-tube. After the patient has been dismissed from the hospital the size and configuration of the common bile duct and its ability to empty bile adequately into the duodenum are determined by injecting brominol into the tube and studying the common bile duct under the roentgenoscope and by roentgenograms. Such cholelithochography will reveal the presence of overlooked stones, will reveal persisting pancreatitis with narrowing of the bile duct, will reveal the presence of a disturbance of the sphincter of Oddi, and will reveal reflux of bile into the duct of Wirsung (Fig 4). Obviously, persisting stasis in the common bile duct from whatever cause, and with infection continuing to exist within the biliary tract, the possibility of the reformation of stone of the common duct is great, should drainage be



Fig 4 Cholelithochogram showing reflux of bile up the duct of Wirsung

interfered with by too early removal of the T-tube. Generally speaking, the T-tube should not be removed in such cases until the bile duct has assumed normal proportions, until narrowing from pancreatitis has subsided and until the duct empties in normal fashion. It is in determination of these factors that cholelithochography has been of great assistance.

It has been recognized that residual pancreatitis might lead to recurring attacks of abdominal pain like those of biliary colic but narrowing of the pancreatic portion of the common duct and intermittent swelling of the pancreas as the mechanism by which such narrowing is produced, has not been emphasized. Similarly, too little attention has been given, I believe, to reflux of bile up into the duct of Wirsung as the causative factor of this pancreatic inflammation. Removal of the

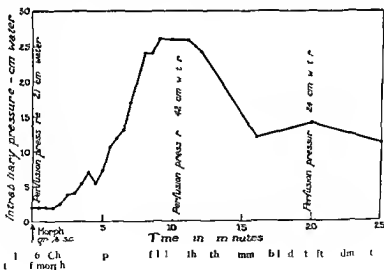


Fig 5 App t f t dy g p ss th th  
t ah p t c b f r y t t (W Go n nd B tsch)

diseased gall bladder and prolonged drainage of the common bile duct are at present the

most effective methods of combating these factors of pancreatitis

Similarly abnormal function of the sphincter of Oddi either from inflammation spasmic contraction or fibrotic stenosis has not received the attention and study which it deserves as a factor in producing biliary stasis. In recent studies on patients who had been subjected to drainage of the common bile duct by T tube my assistants Drs McGowan and Butsch of the Mayo Foundation have demonstrated that the pressure within the common bile duct can be made to increase from a normal of 0 to a maximum of 20 to 32 centimeters of water within a period of 7 minutes after administration of  $\frac{1}{6}$  grain (0.01 gm) of morphine sulphate (Fig 5). This pressure is sustained for 15 minutes then it decreases to about 14 centimeters and this is maintained for 2 hours (Fig 6). In one case that of a woman who had had persistent attacks of biliary colic without demonstrable stone the colic was apparent to the patient after administration of morphine when the intraductal pressure reached its maximum. This also was true of a patient from whose common duct stones had been removed. In the first case pain was partially relieved by eating and particularly following drinking of cream both of which tend to relax the sphincter of Oddi. In a few cases similar spasm or contracture of the





lower portion of the common duct, which has been assumed to be at the sphincter of Oddi, has been demonstrated on cholelithography. Mirizzi has referred to the roentgenographic picture of this narrowing as indicating sphincteritis. In one of these cases the persistent contracture of this portion of the duct was explained later by finding at the papilla a small carcinoma which had not been palpable nor demonstrable at the time of operation (Fig 7). An attempt is being made to correlate the painful increase of pressure within the common duct, the emptying time of the duct, and the action of the sphincter of Oddi by using brominol to determine pressure within the duct and observing under the fluoroscope the passage of the brominol from the common bile duct.



Fig 7 Cholelithogram, showing dilatation of the common duct, abruptly terminating at the ampulla due to carcinoma of the papilla of Vater

Release of this spasm of the sphincter of Oddi probably has been accomplished satisfactorily by dilatation with the graduated scoops which are passed through the sphincter into the duodenum when the common bile duct is explored. I recall several cases in which, when attacks of biliary colic recurred subsequent to operation, the passage of large scoops through the tight sphincter was followed by disappearance of the attacks of colic. Should they persist after such a procedure, the advisability of making an anastomotic opening between the common bile duct and the duodenum, as has been suggested by Strauss and his co-workers, or of performing transduodenal division of the sphincter of Oddi is undoubtedly worthy of consideration. Before coming to definite conclusions as to the benefits of therapy of such a condition it is recommended that as much information as possible be obtained regarding the mechanism of the sphincter of Oddi in relation to disease of the biliary tract.

#### SUMMARY

One or more stones may be present in the common bile duct without producing jaundice. Such stones may produce biliary colic or intermittent fever or both, and either one or both together may be associated with pylorospasm. The increased diameter of the common bile duct is a sign of its obstruction, and the obstruction may be attributable to

stones or to a pancreatic or other obstruction. In many cases, continuance of symptoms of disease of the biliary tract subsequent to cholecystectomy can be attributed to the presence of forgotten stones of the common duct or to persistent inflammation of the pancreas or sphincter of Oddi, any of which may obstruct the passage of bile into the duodenum. Factors concerned in the production of stones of the common duct are their expulsion from the gall bladder and the formation of soft bile pigment stones secondary to persistent obstruction of the common duct in conditions such as pancreatitis and sphincteritis. Studies of the bacterial flora of bile removed from the common duct in cases of disease of the biliary tract disclose in most cases the presence of bacilli of the gram-negative or colon group, or streptococci or staphylococci. All of these are present in some cases. Bacterial studies of bile and analysis of removed gall stones are as necessary to similar studies of the urine and urinary calculi, for since urinary infections have been

demonstrated to respond to increasing acidification of the urine and to the use of certain substances such as the arsenical preparations used in the treatment of syphilis similar response to biliary infections might result especially if antiseptic radicals were attached to the halogenated phthalins which are excreted through the liver into the bile. Studies of intraductal pressure and intraductal conformation by the use of opaque substances injected into the duct through a T tube have been of value in determining the persistence of pancreatitis or sphincteritis interfering with proper emptying of the common duct and hence have assisted in determining the length of time necessary for

drainage of the duct by using the T tube to be continued.

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TOXEMIA OF PREGNANCY<sup>1</sup>

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THE scope of this article will be limited to the new work which has been done upon this subject in the past 2 or 3 years. Much that will be described in the following pages has not yet had universal approval, still more appears now for the first time.

## I TOXEMIA IN THIRD TRIMESTER

There is but one toxemia of pregnancy in the third trimester, but it has a very protean symptomatology. The reason for this lies in the idiosyncrasies of the patients, and in the susceptibilities and reserves of systems and of individual organs to a common toxicity which bathes all the tissues generally and commonly. The whole of life's activities is a strife of accommodation of a fairly constant internal milieu to an ever-changing external environment. In the case of toxemia of pregnancy, there is an intermediate milieu, the blood and tissue plasma, which is the carrying agency of the toxic product, to which the cell—the center of life—is endeavoring to accommodate itself. When the toxic state is slow in its development, the cell unit and its agglomerate organ has just that much more time to adjust itself to the change. Extended duration is spoken of as chronicity. In such chronic cases, the cataclysm of eclampsia rarely develops, except when an acute exacerbation is implanted upon a chronic state. In acute cases, on the other hand, when the cell unit cannot adapt itself in the short duration of the disease, heightened neuromuscular sensitivity develops—as is the rule in the early stages of acute toxic states, whether bacterial or chemical—and the consequence is a widespread discharge of impulses ending in an eclamptic seizure. So that time, in toxemia, is a very salutary factor in protecting the organism against the major seizure. In acute cases eclampsia develops while in cases that are consistently chronic and progressive coma

develops, for upon the acute irritability, it prolonged, there develops a lowered sensitiveness that permits greater toxic saturation without rebellion, leading eventually to coma. So that *duration* of the toxicity, plus the *degree* of toxicity, on the one side, and the reserve of the individual as to her nervous system and of her organs generally and individually, determine the course of the disease.

## II SUSCEPTIBILITY TO ECLAMPSIA

Susceptibility to eclampsia varies in each individual. It is important to recognize this factor, as it frequently determines the course of the disease. In the Province of Quebec, where according to the French law, marriage is legal in the early teens, many are mothers in early adolescence. It has been found that in these child-mothers the susceptibility to eclampsia is high, owing to instability of their nervous systems in their tender years. World contacts of advancing years harden the nervous system through the bombardment which it sustains ever and ever more equitably as life's years advance.

It is equally true that many women, though chronologically mature, are infantile in nerve development and instability and, as such, are as susceptible as children to the convulsive expression of toxemia, when from their years one might expect a milder form of reaction. I have had only 2 cases of eclampsia in my private practice since my return from the war in 1919. Both of these women were morons, with the mentality and the emotional lack of control of children. They had a minimum degree of toxicity as judged by their signs, and both developed eclampsia during normal labor. The seizures were mild, but numerous. They both were mental cases after parturition, the one, temporarily, the other, permanently. *Per contra*, women whose whole emotional life has been disciplined and controlled, may become toxic to an exceedingly high de-

<sup>1</sup>Read before the Midwest Society of Gynecologists and Obstetricians, Omaha, Nebraska, October 1933.

gree before the toxicity becomes manifest in the form of eclampsia. But when the major cataclysm does develop the course of disease is usually correspondingly severe and not infrequently lethal.

### III. BLOOD PRESSURE

The blood pressure in the early months of pregnancy is very low, ranging between 30 and 60 diastolic and 60 and 90 systolic. This is normal judging from hundreds of computations. It slowly rises in the third trimester under normal conditions but should not exceed 70 to 80 over 100 to 110. In abnormal states blood pressure begins to rise and may reach very high registration throughout the later months.

There is a physiological reason for the early low blood pressure. It is to conserve the embryo and its extracorporeal outgrowths. Were the blood pressure high at this stage severe maternal hemorrhage would increase the extravasations about the delicate fetal placental fronds when the phagocytic trophoblasts open the maternal sinuses and a large percentage of early pregnancies would consequently be sequestered and cast off.

In the third trimester high maternal blood pressure leads to grave placental disease and coincidentally grave fetal circulatory disturbances. It can be put down as a fairly constant rule that progressive high maternal blood pressure is the cause of progressive insidious placental sclerosis which places the life of the fetus in jeopardy by cutting off nutrition and aeration to the fetus thereby bringing about slow strangulation and starvation. We do not get placental infarction (marginalis or otherwise) in cases of uncomplicated toxemia to wit the absence of placental infarctions in eclamptic cases nor does the fetus succumb *in utero* owing to acute toxemia—again witness the high percentage of living children born of eclamptics even in spite of the forceful methods of delivery so frequently employed. Acute eclamptics have placentas singularly free from sclerotic infarctions. Placental sclerosis whether marginal or central is usually insidiously slow in development (From this condition we must distinguish massive death of the placenta.) Placental scler-

osis or infarction is notably associated with high maternal blood pressures. This increases the pressure in the placental maternal sinuses which by virtue of the law of hydrostatics is transmitted equally to all parts of the fetal villous fronds in which the delicate fetal circulation is in operation. As a consequence of the heightened blood pressure the fetal circulation would be cut off if the fetal pressure did not rise synchronously to overcome the external pressure upon its circulation. And disproportion between fetal and maternal circulation brings about in the placenta a sequence of extravasatory events which are conspicuous by their frequency. They are in the nature of liquid edema, inspissated edema (luteinoid), white infarctions (marginal and central), vessel sclerosis, fetal pseudomyx edema and scleroderma. The next big step in exact placental pathology will be a complete differentiation of the lesions due to senility from those arising out of maternal blood pressure and from those due to true toxemia. Since these three conditions are frequently found concomitantly in operation the segregation of the lesions of each of the three causes is not an easy one.

So far however we may go without error first that every placenta lives the life history of all living matter. It has its embryonic, childhood, adolescence, maturity and senility. Senile changes begin in the placenta at about the seventh month and reach in the majority of instances advanced stages at full term. It may at once be objected that the placenta has not discharged its full function until the birth of its dependent child and the demands made upon it should increase with the growth of the fetus. Casually this seems correct. But on closer study we find that in early embryonic life after the allantois or yolk sac has atrophied we find the fetus is dependent upon the placenta for the transmission of its every requirement. This until about the seventh month. Prior to this date the placenta is a virtual storehouse of accessories. After the seventh month the fetus begins to elaborate in its own organs some of its needs. This grows progressively so that in the end the fetus is self-sustaining except for the need of oxygen and its effects together with partially

assimilated food, to be used chiefly for kinetic or potential energy

#### IV CLINICAL VARIETIES OF TOXEMIA

There are at present, many dissimilar clinical diseases classified under the term "toxemia of pregnancy." It will be our duty in the near future to endeavor to dissociate these into their respective and proper categories. For the present we may indulge in a few broad statements relative to the cases. Not all high blood pressures in pregnancy are due to toxemia of pregnancy. As a matter of fact, the great majority have nothing in common with toxemia.

High blood pressures are commonly associated with progressive placental edema, deposition, and sclerosis. Toxemia does not affect the placenta in this manner.

Toxemia produces placental hemorrhages and placentosis. Retroplacental and intraplacental hemorrhages are notably found in true toxemic cases and usually in the low grade types of toxemia, cumulative and of long standing, but rarely with a blood pressure of over 125 systolic. Placentosis, and its final expression, massive death of the placenta, are found in the acute true toxemias. The vast majority of cases of clinical toxemias that we meet with in the wards, have no symptoms, and the only signs are a progressive pallor and an intractably rising blood pressure. These are not cases of uncomplicated toxemia. They are toxemic cases only possibly in a secondary way. But primarily, the blood pressure arises out of dyscrasias other than those due to pregnancy. They are the types of cases that the internist speaks of as idiopathic blood pressure—a term that has no meaning and is used to cloak our ignorance. They constitute the great majority of the patients who have persistence of high blood pressure after delivery and eventuate after some years into chronic cardiovascular-renal cases, the end-result of a persistent high blood pressure which is merely the sign of a vitiated metabolism of long standing and of a certain intensity. Pregnancy is, in such cases, merely an incidental association, not without its influence upon the primary disease, and not always a baneful associate, as will be shown later.

#### V NEPHROSIS VERSUS NEPHRITIS

Two years ago I published the detailed histories of 5 patients who had been observed for many years, hospitalized and under observation by professors of internal medicine, and upon whom every chemical and cytological test had been done, resulting in a final diagnosis of chronic nephritis. These patients were warned against pregnancy, owing to the serious consequences which it would entail. They were sent to me later when about 3 months' pregnant, to have a therapeutic abortion performed. The first one demurred, and I compromised, allowing her a full protein diet for 2 weeks, with the implied condition that if she did not show a fall in blood pressure and a reduction in albumin, the abortion would be performed. At the end of 2 weeks the blood pressure had fallen 20 millimeters, 2 weeks later about 20 more, now at 90/140 millimeters. At 4½ months the albumin had disappeared, except for a faint trace, and the blood pressure had fallen to 110, from a steady 180, which had been more or less consistently present for 3 years. Mrs. K. had a normal delivery, a normal child, normal placenta, and a normal puerperium. Her blood pressure subsequently was never over 110 millimeters, and she has been under my observation since. She gained 29 pounds during her pregnancy, never felt better, and I delivered her 2 days ago, October 18, 1935, of her second child, and her course was perfectly normal. Blood pressure never was over 110 millimeters, and there was a faint trace of albumin from the fourth month on. There was an occasional cast during the pregnancy. The 4 other cases were almost similar. The singular thing is that improvement, in each case, began at about 3½ months of pregnancy, and the apparent cure was complete at about the fifth month. An explanation on the basis of a hyperposterior pituitary with a low reserve in the gland, was contended. Since this publication, there have been 7 other cases brought to my attention, by professors of other schools, or by my colleagues. Professor Fahmy, of Edinburgh, wrote me of 2 similar cases.

So that, so called nephritics do not necessarily react adversely by the imposition of a pregnancy. But we at once ask ourselves—

what is nephritis? The internist must answer this question. Certain it is that a true nephritis resultant of an inflammatory change in the kidney could not conceivably be improved by a pregnancy. What were these cases then? Most decidedly they were nephrotics. And what is nephrosis? A change in the secretory elements of the kidney of the nature of fatty degeneration brought about by an endocrine dysrasia of considerable duration and intensity producing albuminuria casts blood pressure hematuria and even suppression of urine but capable of rapid restoration of function when the cause is removed leaving the kidney damaged in proportion to the intensity and duration (chiefly duration) of the causative agent. In this respect it differs from nephritis in that function apparently to full capacity can be restored in an incredibly short period of time. In many instances the restoration is not *ad integrum* for an increased porosity (if I may use that term) of the kidney frequently remains expressed in a constant trace of albumin. What the effect will be in the cases quoted over a long period of years I cannot even venture an opinion for they have been at most only 3 years under observation. None of them presents other than a fairly constant trace of albumin both in pregnant and non pregnant states. The posterior pituitary secretion has been shown to contain four ingredients

1. An oxytocic substance (pituitrin pitocin etc.)

2. A melanophore substance that controls the distribution of pigment in the body

3. A water retention substance

4. A pressor substance

These substances varying in amount in the circulation over and above the needs of the body produce a disturbance of function which is very varied in symptomatology. Not only that but we may state that one cannot have a wide departure from the normal by any one gland without entailing an upset in all the others that are intimately correlated with it in function. So that most of the major type of glandular dystrophies are pluriglandular though probably uniglandular at the outset. Hoffmann and Anselmino have

shown an excess of the posterior pituitary substances in the blood of toxic pregnant women. These substances were consistently present in toxic cases and consistently absent in non toxic pregnant cases. Some doubt has been thrown upon the work but their results have so much verisimilitude that they have a great appeal and have the virtue of that old philosophical adage that what ought to be is. However it is the only theory that will explain the symptomatology and I know that the scientific world is fairly unanimous in accepting the endocrine theory of toxemia of pregnancy.

It will be emphasized later that not only the posterior pituitary possesses a pressor substance we find it also in suprarenal thyroid and parasympathetic overactivity. It has now been demonstrated beyond doubt that the parasympathetic nerve endings under excessive stimulation produce a substance acetylcholine which has all the properties of suprarenal extract and is a pressor substance. This is not surprising when we realize that the suprarenal core is made up of tissues similar in histology to the autonomous nervous system and moreover that the suprarenal is merely an agglomerate offshoot of the parasympathetic.

The importance of the endocrine system is growing daily in our concept of disease. Every function of the body is under the control of another function and the ultimate control rests with the glands of internal secretion and the master control resides in the dominating influence of the pituitary. It can now be said with every indication of complete veracity that in cases other than traumatic and bacterial the initial steps that lead eventually to death are inaugurated by an endocrine imbalance first setting up a progressively vitiated function which spells vitiated metabolism which in turn spells a progressive blood content of abnormal products which the body corporate at first neutralizes but with which it cannot cope for any prolonged period without entailing the downfall of the compensatory glands that have come to the rescue of the gland that was primarily in distress. I see this so often that I make the statement with all the assurance of a truism.

## VII NERVE MUSCLE IRRITABILITY IN TOXEMIA

This is a new clinical concept. Nerve muscle irritability is increased in the acute toxemias, and is lowered in the chronic cases. These statements seem at first, at variance. But they will be found to be in accordance with experience in other allied states of disease. We find that in bacterial toxemia, the acute steps of the disease usually present a heightened nerve muscle irritability, and that this passes into a lowered state when the disease has lasted a longer period of time—witness the acute restlessness of the early stages of typhoid, and compare with the lethargy of the late stages. Many of the great literati of the world were tuberculous, and their productivity was proportionate to the acuteness of the disease. In the periods of recovery, when corporeal curative forces were in the ascendant, the mental activity became lowered proportionately. The virus of tuberculosis is particularly stimulating to brain and spinal cord, and this property is shared largely with other bacterial toxins. And in this respect, the toxins of pregnancy are not exceptions.

Witness the cataclysm of eclampsia, where probably the initial overcharge in a single cell, or group of cells, spreads throughout the brain to set up the general convulsive seizure, due to the heightened nerve muscle tense which makes the organisms ripe for such a widespread involvement. Physiologists tell us that the outgoing impulse may be out of all proportion to the afferent stimulus, and here we have a very potent example of this. This leads up to the following explanation—uterine irritability is increased in acute toxic states. Need I mention the fact that the uterus usually goes into spontaneous labor after the first few convulsive seizures? *Per contra*, uterine nerve muscle irritability is lower in the chronic toxemias, and these cases will frequently tax the ingenuity to its utmost, to put them into labor. It is well to recognize this fact in determining the line of conduct in endeavoring to empty the uterus in the interests of the unborn child.

Doubtless the lessened nerve irritability of chronic cases extends to organs other than the

uterus, but we know no easy method of determining such a change.

## VIII CELLULAR CHANGES IN THE BLOOD IN PREGNANCY AND TOXEMIA

In conjunction with Dr. Rudolf Gottlieb, a cellular study of 300 cases was made, and some interesting results have followed. It was found that in a very large percentage of cases there is a progressive hypochromic anemia, reaching its maximum during the last days of pregnancy. The fall in the coloring matter in the red cells is particularly rapid in the last month of pregnancy. We found that the anemia was less marked in cases in which the pregnancies were not too rapid in succession, but was very pronounced in cases in which intervals of less than 2 years occurred between pregnancies. In these cases the fall is quite alarming at times.

It has also been found that many of the symptoms which heretofore were attributed to toxemia, really arise out of the anemia, such as, for example, numbness of the forearms on awakening, some swellings of the hands and feet, general weakness and neuralgias. Moreover, there was also a general increase in the incidence of toxemia in the anemic cases. Associated with the anemia, we found a marked diminution, commonly total absence, of hydrochloric acid in the stomach. This is progressive with the anemia, and is probably the primary cause of the anemia. This leads frequently to digestive upsets, with fermentation, heartburn, and glycosuria disturbances. Thus achlorhydria persists for some weeks after delivery, but in many of the milder cases the return of gastric function is established during the 2 weeks following labor. In other cases, where pregnancies have followed one another in rapid succession, the achlorhydria may be permanent, as is also the rule with the consequent anemia. The achlorhydria and the hypochromic anemia stand in relation to each other as cause and effect.

These cases respond almost magically to large doses of iron. The chloride of iron has proved the best preparation, but it presents administration difficulties. The most satisfactory substitute was found in the scaly

preparation the citrates. These must be administered in large doses of 90 grams or so daily. Its best vehicle is malt or wine. Its action is enhanced by the administration of 5 to 10 minims of hydrochloric acid separately. Occasionally the iron produces diarrhea and upon this occurrence the dose must be reduced. In addition it was found that in true toxic case there was a decided shift to the right in the white blood cells sometimes so pronounced that the toxemia was forecast several days before clinical signs were detectable.

#### IV. CHEMISTRY OF THE BLOOD IN TOXEMIA

Blood chemistry in toxic cases has been very disappointing. The reports come back from the laboratory with monotonously normal returns showing no evidence what ever of retention products or other disturbances. There is little or nothing that will help in a differentiation or a prognosis. It has been of value however in showing us that even in the gravest cases of toxemia we are not dealing with a nephritis but with a nephrosis in the early stages of which there is no evidence of retention of waste products. When the blood chemistry shows a heightened retention of waste products a consequence of renal insufficiency of a grave character already the diagnosis of nephritis is usually easy by ordinary clinical methods.

The contention that a high uric acid content in the blood is a grave prognostic sign has not been substantiated in our observations.

#### V. DIFFERENTIATION OF CASES COMMONLY GROUPED AS PREGNANCY TOXEMIAS

This is far the most difficult part of this paper because as yet our knowledge of disturbed functions in disease processes leaves much to be desired. However light is breaking through. The exposition of the subject (as it appears to the author) in such a short paper must necessarily be incomplete. Greater details must be held over for the publication of the monograph which will follow in due course.

Needles to say that at present there are several widely different pathological states

classed under the generic heading toxemia of pregnancy.

So far it is possible to classify cases as follows

- A True toxemic (pre eclamptic) { Acute  
Chronic
- B Hypertensive
- C Nephritic (a sequence of antecedent inflammatory disease)
- D Nephritic (degenerative)

**Group 1** Cases of true toxemia of pregnancy fall into 2 groups the acute and the chronic. The division is of course somewhat arbitrary but it serves a very useful purpose. These are frequently denominated as pre eclamptics. Acute pre eclamptics may be divided into four clinical types (1) renal (2) hepatic (3) hemorrhagic (4) neural. These subdivisions of clinical types devolve from individual idiosyncracies in response to a single common toxic agent. The variety in character of the evoked symptoms and signs depends not upon the toxemia as much as upon the susceptibility or instability of the various systems and functions of the afflicted individual. In these cases the renal or hepatic or the vascular or the nervous system may develop the high colors of the clinical picture. This subdivision also has a prognostic value in that some are readily amenable to treatment while others are not.

In the acute renal toxemia we have the common type of pre eclamptic. There is acute water retention as evidenced by general edema, great and sudden increase in body weight, rising blood pressure (this may be absent in multiple pregnancies), distention of the skin vessel especially of the face, marked plethora, reduced urinary output, albuminuria, casts, hematuria or complete suppression, disturbances of vision, dark flashes of light, frosted glass vision, blindness, absence of changes in the fundi except papillary edema, no evidences of cardiac hypertrophy, headaches, neuralgias and psychoses. These if not arrested will end in eclampsia and eclampsia.

It has been an insoluble problem to many why eclamptics may subsequently bear a large family uneventfully whereas others who have suffered from more chronic states of the





and a slight disturbance of the emunctories. Usually the first evidence of trouble is an eclamptic seizure. The seizures are usually repeated at short intervals and consciousness seldom returns after the first fit. The intervals are frequently filled with muscular twitchings passing at intervals directly into frank seizures. These are the cases that are frequently compared in the suddenness and unexpectedness of onset to a bolt from the blue. To the undiscerning eye there were no clouds to denote the impending storm. The prognosis is poor for both mother and fetus.

The chronic cases of true toxemia differ from the acute in their slow insidious onset and gradual progressive development of symptoms and signs gradually increasing albumin and blood pressure signs of defective vision headache and vomiting and edema. One sees in retrospect in the records of the antenatal clinic a gradual exacerbation of the signs and symptoms. Many of the milder cases yield to modification of expenditures of energy and of diet. In other the improvement is merely temporary. When hospitalized and placed under stricter regimen the majority improve frequently only to return at a later period with a recrudescence. A percentage when hospitalized improve for 3 or 4 days as evidenced by increased output falling blood pressure and general symptomatic amelioration. But in a small group the blood pressure begins to rise on the fourth day in spite of the improved environment and this must be considered a very sinister sign. It can now be stated as an axiom that the longer a chronic toxemia lasts the greater is the consequent damage upon the organism and the greater are the chances that the initiated vitiated metabolism will continue after cessation of the pregnancy.

*Group B The hypertensive class* These constitute a large percentage of the so called toxemic cases. Virtually they are not pregnancy toxemias at all. They are the types of cases which arise in medicine and are grouped under essential or idiopathic hypertension a term which has no significance except to connote that we know not the cause.

These cases are usually symptom free or of so slight a character as not to be characteristic. Heightened blood pressure is the one constant sign. It is progressive and sinister in its rise usually unaffected except temporarily by treatment. Blood chemistry is negative except in the advanced cases. Albumin is absent in the majority of cases and there is never more than a faint trace when present. Casts are very few and of the hyaline or finely granular types. The blood pressure may have antedated the pregnancy or may have started early in the pregnancy. These are the cases in which there is a strong tendency for the blood pressure to continue following upon delivery and if the dyscrasia which produces the blood pressure persists long enough the case will eventuate in a cardiovascular renal sclerosis. That this is primarily an endocrine dyscrasia is borne out by many arguments. The pregnancy may be the primary exciting cause which upon its termination may cause a return to the normal. This type of case is expressive of a hypersensitiveness of certain glands of internal secretion. In pregnancy as we all know exercises greater changes in the internal glands than in any other systems the uterus being the only exception to that statement. It is natural therefore that it should be the cause of hypertension in many cases where glands which form hypertensive substances are unduly stimulated by the pregnancy. I have seen this frequently in the hyperthyroidisms of pregnancy when the overresponsive gland returns to normal function after each pregnancy and the blood pressure and other symptoms also subside. But in several instances under close observation the glandular function does not subside in the puerperium but goes on eventually to card and other lesions secondary to the disturbed metabolism. So it is in cases of suprarenal dystrophy. In many of these cases where the dyscrasia antedated the pregnancy the pregnant state then becomes merely either a contributory ameliorating or associated factor.

If the hypertension has preceded the pregnancy for a considerable time cardiac change of an hypertrophic nature may be demonstrable. When placed under favorable circumstances

stances, the blood pressure almost invariably shows a slight fall in the first 3 days. Otherwise, there is no change. On the fourth day, the case resumes its pre-treatment course. The fundi are negative, except in the rare case of long standing.

Patients who develop high blood pressure at the menopause run a similar course. The cause is undoubtedly an endocrine imbalance, arising out of the sudden withdrawal of the ovarian secretion, acting upon a supersensitive organism. In the majority of such cases the condition subsides spontaneously, while in others it does not. Many other contributory causes may be enumerated, such as emotional shock, chronic focal infections, chronic gastro-intestinal disturbances, especially mucous colitis. These, though dormant for a considerable period, may be brought into sudden prominence by the associated pregnancy, but are virtually independent of the pregnancy which becomes only an added contributory factor. In other instances, the pregnancy may use up the excessive gland secretion and cause a decided improvement and a cessation of the dyscrasia subsequently. These states of high blood pressure are not immediately dangerous to the mother, but they exercise a most pernicious influence upon the placenta, causing edema, fibrinosis, insidious progressive infarction, and slow starvation and death of the fetus. A study of the mothers over an extended period, will show recovery or progressive arteriosclerotic changes.

*Group C Nephritics (inflammatory)* These constitute the group of cases in which, owing to antecedent disease, such as acute fevers, the kidneys have become the seat of irreparable damage, and the pregnancy then becomes a complication of nephritis.

In a percentage of cases, the kidney lesion is demonstrable prior to pregnancy. In others, there is a history of nephritis, with an improvement sufficient to wipe out clinical signs. In still others, the condition is not known until brought into relief by the pregnancy. The amount of previous damage to the functional capacity of the kidney, in these cases, will determine the early or tardy appearance of renal insufficiency in the months

of pregnancy. Careful examination of the cardiovascular system may show hypertrophy, the changes in the fundi are of the albuminuric type, the fundal blood vessels may present the silver wire appearances. Blood chemistry may show evidence of retention products, owing to renal insufficiency.

*Group D Nephritics due to degeneration* Into this interesting group there enters a large number of cases. As the term implies, it is a degenerative change due to wear and tear, and in the last analysis, is endocrinological in origin, just as senility is probably primarily of endocrine origin. There are all degrees of this senile degeneration, from the degree of inappreciable diminution of the kidney reserve, to the degree at the other extreme of renal incompetence, to the daily round of energy expenditure and eliminative work. The usual history, as regards pregnancies, is that there may be several normal pregnancies, followed by a series with renal incompetence which manifests itself at first, late in the pregnancy, and in the subsequent conceptions the renal faltering shows up earlier and earlier in the gestation period. Or, we frequently obtain quite another history—a series of normal pregnancies followed by a long interval in years of hardship, and the manifestation of renal incompetence in the subsequent gestations. These cases are, I repeat, very common. Circumstances of environment may improve, with a corresponding improvement in general corporeal tone so that an apparently normal pregnancy might follow upon one of slight renal insufficiency (when the general health was depleted by circumstances) and the normal interjection may again be followed by other pregnancies with the renal state much to the fore in symptomatology. It must be inferred from the foregoing that the renal impairment is only part of a general ageing, though the renal may be in advance of any other system degeneration, for few people degenerate at an equal rate in all their organs. Close examination of these cases may show cardiac hypertrophy, but all other examinations will prove absolutely negative. These cases preponderate in the third and fourth decade of life, but are not unknown in the early ado-

lescence They are the types that are frequently spoken of as kidneys of low reserve but I would not that you should infer as do some authors that by this term I imply that the condition is congenital On the contrary it is an acquired state of premature senility though one might easily imagine that there would be the very occasional child who is born with kidneys too small for their economy Such cases however must be very rare about in the same proportion as we find microcardiacs micro-ophthalmics etc and to these few if they are diagnosable we might apply the prefix *micronephritics*

So it will readily be seen that though theoretically we may categorize all cases of toxemia yet practically a great deal more scientific refinement of methods must take place before all cases can be placed in their proper group Moreover if any individual were merely of one type of intoxication or degeneration the matter would be relatively simple But there is no reason why a nephritic of either type described above may not also have a pregnancy toxemia superadded to her other affliction This naturally complicates the matter very seriously though not insurmountably

Associated with or following upon some of these maternal corporeal defects there arise placental changes that are very definite but difficult of interpretation That certain placental pathological changes are practically uniformly discovered in association with certain maternal abnormal states cannot be gainsaid

Recent research into placental pathology has shown that there are lesions that are found with great frequency and when taken in conjunction with a careful antenatal record it is possible to connect certain lesions with certain clinical signs

The lesions that are most commonly found in placentas at term are (1) chorionic sclerosis and (2) subchorionic degeneration (3) placental hemorrhage (4) infarctions (5) degeneration cysts

Chorionic sclerosis and subchorionic degeneration seem to arise out of senile changes accentuated by nutritional changes incident to obstruction to the placental circulation

It is rare to find a placenta at term that is not the repository of this exudative clogging fibrinosis which in its in position from plasma to fibrin tissue contracts and cut off a great deal of the fetal circulation This exudate is deposited chiefly in the lamina of the chorionic plate and between the amnion and the chorion In consequence of this deposition the underlying fetal villi undergo marked degeneration and absorption leaving their main vessels thickened and white and with dimensions many times their original size Coincidental with this there develops a hyaline degeneration of the maternal intra-placental septa with enormous swelling in which the individual cells assume proportions as high as twenty times their original size and all differentiation of nucleus and cell protoplasm is lost and they frequently stand as enlarged phantoms of their former selves This sclerosis especially of the chorionic plate is the predisposing factor in the development of circumferential and circumvallation of the placenta<sup>1</sup> I am fairly convinced that the placental exudate and subsequent fibrinosis is the result of obstructive fetal circulation and that this in turn is the direct result of maternal high blood pressure It is difficult in placental pathology to distinguish between the changes induced by maternal toxicity and those due to maternal hypertension To a certain extent that has been possible for it is now almost certain that chorionic sclerosis and exudate depend upon maternal hypertension This condition is enhanced by the senile changes incident to post maturity that is after the seventh month Upon this perivascular sclerosis depends a great deal of the slow insidious coagulation necrosis which passes under the generic name of *white infarcts*

#### PLACENTAL

Placenta is a new discovery The terminology implies an embryological causation It is the product of acute toxemias and is the direct expression of toxemia upon a peculiar tissue There are acute diffuse cases in which the whole placenta is affected but usually throughout leading to pathen-

margin of chorionic plate.

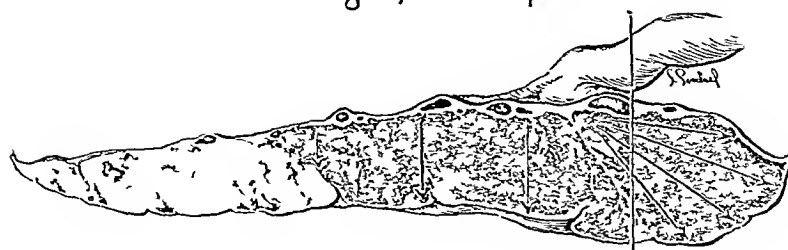


Fig 1 Infarcted placenta, showing compensatory hypertrophy Lines of growth tension Eccentric circumcrescence

*masse* of the whole placenta. The placenta, in the early stage of the disease, is blue black in color, engorged vessels course over the amniotic surface. The tumefaction, owing to congestion, may swell the thickness of the placenta to 3 inches. On section in the fresh state, the placenta oozes blue black blood for a long time, and diffuse irregular hemorrhagic cavities abound throughout the substance of the placenta. If the child dies in the following days, the placenta gradually changes color to a golden yellow, due to diffuse fatty degeneration of all its cells, blood pigment is found gathered in clusters, and if the placenta be retained for some days *in utero* and retain its maternal attachment, absorption goes on rapidly, and the placenta becomes gradually thinner by the absorption of the delicate villous tissues, which, owing to their more embryonic type of development, are broken down more quickly than the more resistant maternal portions of the placenta. Under the microscope, in the acute stage the villous capillaries are distended to the degree that they actually impinge upon one another, and the intervillous tissue is almost obliterated. Vessel walls are frequently broken through from fetal vessel to fetal vessel, and in the center of each cotyledon is a large coagulum, where maternal and fetal blood seem to have mixed.

The process, however, is not always so acute. There are subacute cases, in which recovery of part of the placenta takes place, while the other part undergoes the changes described above. When this happens, we have a condition of thin atrophied placenta in one-half or more of its diameter, with a

line of demarcation between the living and the dead portion (see Fig 1). The living portion gradually grows thicker the farther one recedes from the dead portion, and at the most remote margin, recovery may have been so complete as to permit a compensatory hypertrophy to develop. It is as if, near the line of demarcation between the dead and the living tissue, the hold upon life of the cells within the living tissue was precarious, and therefore not sufficient to permit hypertrophy, but only life with limited or no special functions. The reasons for the selective influence upon the placenta, whereby one portion dies and another lives, depends primarily upon the lie of the placenta in the uterus, and the consequential differences in the maternal vascular supply that follows. For it must be emphasized that the uterus differs a great deal in richness of blood supply in its different regions. This will be dealt with at length in the details of the monograph. In more chronic cases one may find recovery and insidious chronic placentosis going on simultaneously in the same placenta.

#### HEMORRHAGES

Among the 1000 placentas that have been submitted to careful scrutiny, both before and after hardening and sectioning, over 600 showed macroscopic hemorrhages, varying in size from an orange to a millet seed, thereby proving that hemorrhagic disease is one of the most common pathological entities. And yet in only 11 of these 600 cases was the clinical diagnosis possible. In 10 of these the child died *in utero*, in the eleventh, the child's life was in jeopardy during delivery. Hemor-

rhagic disease of the placenta is an expression of toxemia and of toxemia only

#### DEGENERATION CYST

Degeneration cysts of the placenta are very numerous. They vary in size from an almond nut to a millet seed. When present in a placenta they are usually very numerous. They are the expression of a hyaline degeneration of masss of decidual cells with progressive liquefaction to the consistence of jelly. The liquefaction and clarification proceeds from within outward the wall being made up of decidual cells in a better state of preservation the farther one recedes from the center of the cyst. Macroscopically the clear transparent content is always of a pale nile green. They have no clinical significance and pathologically they are merely an expression of a special form of degeneration of a special tissue.

#### TREATMENT

Treatment resolves itself into that of acute and chronic cases.

*Acute cases* inclusive of eclampsia. In this type of case the whole line of treatment should have for its object to allay nerve irritability and promote elimination. Sedatives are indicated. Morphine is usually the one most readily at hand. Other agents quicker and more certain of action are luminal sodium amytal nembutal and avertin the last with caution. If the pressure is high and there is any sign of papillary edema or severe headache bleeding is indicated followed by a small amount of intravenous hypertonic solutions of sugar sodium chloride or magnesium sulphate. The injected fluid should be the equivalent quantitatively of about one quarter of the blood withdrawn. Both these treatments promote a return of the excessive extravascular cell plasma into the blood vessels and a general relief of cell pressure but of greater implication and importance is the relief upon the cerebral neurones. The emunctories should be stimulated by catharsis or bowel lavage. Magnesium sulphate in concentrate usually answers best. Diet should at first be completely restricted. Later milk and carbohydrates and vegetables should be added to conserve body weight. If there is a

heavy loss of albumin through the urine proteins may frequently be administered with advantage.

In that toxemia of pregnancy is an endocrine dyscrasia of the hyperfunction variety all physical bombardment of the hypersensitive nervous system should be avoided by protecting the senses and emotional strain and stress should be eliminated.

The problem of interference to terminate labor in the acute stages of the disease does not permit of unanimity of opinion. My own line of action is as follows. In primiparae with severe eclamptic seizures following in rapid order and a closed cervix cesarean section is the indication. In multiparae the past history as to labors must be given weighty consideration. In cases in which labor has been easy and rapid induction by rupture of the membranes usually will suffice but due consideration must be given to the severity and frequency of the attacks together with the intensity of the coma and the facial appearance. In the severe type cesarean section will commend itself. In the milder form the less drastic manipulation will claim your choice.

In the less severe types of pre eclamptic toxemia consideration should be given to palliative treatment as a preliminary to evacuation when improvement has been effected.

In the chronic pre eclamptics as well as in the other types the hypertensive and nephritics one usually has ample time to give the case considerable thought. During this period of rest restricted diet and stimulation of the emunctories one can study all the contingencies of the cases. Besides the primary study of the mother there enters the prospect of the unborn child the economic and social status the absence of children or the presence of many together with a consideration of their age and independence. In fact everything that is even tangential to the case must be weighed carefully. Knowing that in the chronic cases the longer the prenatal hypertension lasts the greater is the likelihood of its persistence afterward and its ultimate result upon the organs knowing also that in the hypertensive cases and nephritics (inflammatory and degenerative) irrepairable damage

is being inflicted upon the maternal organism, knowing also that it is in those cases with high blood pressure and paucity of symptoms, that the insidious placental changes are found, placing the child's life in jeopardy, these and other considerations must be placed intelligibly before the parents for their sanction and your recommendation. Then, and only then, are we free to act, and the day has gone by when we are justified in carrying a patient to

the last ditch of resistance, to gratify our pride of accomplishment in obtaining a living, viable offspring, at a price paid by the mother—at a price which neither she nor her husband would have undertaken had they known the immediate risk and the more remote sequelæ. Such a decision must rest with those most intimately concerned, after every contingency known to science has been placed in the rational balance.

# APPENDICITIS IN THE SMALL HOSPITAL

A CRITICAL ANALYSIS AND DISCUSSION

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**A**PPENDICITIS is the most prevalent acute surgical condition. It is no respecter of persons or places and occurs in the small hospitals as regularly as in the large. Every year there are more than 600,000 cases in this country with over 18,000 deaths. Inasmuch as one fourth of the general hospital in the United States contain less than 50 beds apiece, it is worth while to inquire how they handle this problem and how their results compare with those of the larger institutions. The staffs of these large hospitals and centers of medical education have written many articles giving their opinions about the diagnosis, operation, and after care of appendicitis. There is however a scarcity of published information on this subject from the small hospitals.

This paper will deal with the appendicitis experience since 1920 of an approved 42 bed country hospital. At that time the author became affiliated with it as surgeon and since then 60 cases of acute and purulent appendicitis have been treated in it.

A survey of the literature shows that the average death rate from appendicitis in this country is approximately 3 per cent but that this varies greatly according to the type of the disease. The chronic cases have a mortality of less than 1 of 1 per cent, the acute cases among which hereafter we shall include the purulent, have about 5 per cent, the purulent ones alone about 20 per cent. The mortality rate in this series is 2.98 per cent for total cases, 0 per cent for chronic, 3.4 per cent for acute, and 15 per cent for purulent. Since 1920 it is still lower, viz. 2.1 per cent for total cases, 2.25 per cent for acute, and 13.4 per cent for purulent (Tables I and II, Charts 1 and 2).

Further generalizations for acute appendicitis in the United States show that  
1. The percentage of males contracting the disease is a little greater than that of females.

In our series the opposite is true, viz. 54 per cent females and only 46 per cent males (Chart 3).

2. The mortality among males is greater in this series also, viz. 4.5 per cent for males and 2.5 per cent for females (Table I and Chart 3).

3. About 70 per cent of the cases occur within the ages of 10 and 30 years. In this series 64 per cent did so (Table VII and Chart 4).

4. Patients operated within the first 24 hours have the best chance of recovery while those done on the third day show the highest mortality. Our experience has been the same.

5. Children under 10 years and adults over 60 years of age are the poorest risks. In this series it is likewise, as 30 per cent of the deaths and only 11 per cent of the cases occurred in these decades, although there were 3 cases with no deaths in the eighth decade (Table VII and Chart 4).

6. There is no seasonal incidence although a few less of our cases occurred in the winter (Table VII) (11).

7. A leucocyte count over 20,000 most always means perforation (10).

8. The slightest displacement of neutrophils to the left, the better the prognosis, whereas a leucopenia is an ominous sign (9, 10).

9. Leucocytosis from 20,000 to 40,000 with an absence of eosinophilia means peritonitis (10).

10. Vomiting is the most important clinical symptom (10). Tenderness is the most important clinical sign.

11. Re-operative catheter is greatly aggravated by the condition.

12. Ample fluid intake after operation is imperative. With these generalizations this series concurs.

Considerable difference of opinion however or at least lack of unanimity exists in the



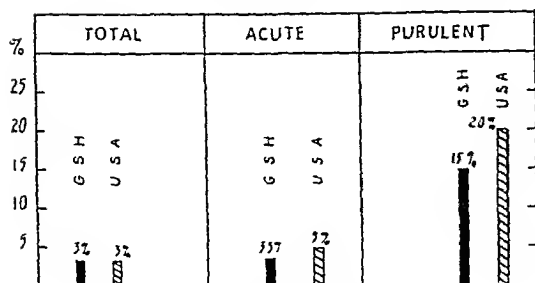


Chart 1 Mortality rates, 1920-1935

literature regarding the type of incision, the treatment of the stump, drainage, cecostomy, ileostomy, and serotherapy. Many surgeons have returned to the McBurney incision and claim better results with it in every way including a lower mortality. Others, including myself, seldom use it, except for stab wound drainage, and have equally good results. My usual incision is made over the right rectus muscle, and, following the Battle-Kammerer technique, the whole muscle is retracted medially in males or laterally in females. Thereby much better exposure is gained, the incision can be lengthened more easily, far less trauma to the appendix and adjacent structures results in the more difficult cases, and in the adult female exploration of the pelvis and operation are readily performed. In fact, for many years I have taught that to use the McBurney incision in a woman is to invite trouble. I have not had a postoperative or incisional hernia in this series, although one case eviscerated. That was an associate's patient 72 years of age, and she is still alive 2 years afterward. In the aged patient, however, we are in accord with Taylor, who states that the best chance of recovery is provided by drainage of the appendix area through a stab-wound over it with a minimum of peritoneal disturbance.

TABLE I—APPENDICITIS 1920-1935 IN GOOD SAMARITAN HOSPITAL

	No	Deaths	% Mortality	Average % for large hospitals
All types	670	20	2.98	3*
Acute	602	20	3.32	5†
Purulent	126	19	15.08	20‡

\* 3.1 per cent (Davis) 3.7 per cent (Harris)  
 † 7.7 per cent (Krech) 5.5 per cent (Donaldson) 3.4 per cent (Cayford)  
 ‡ 17.9 per cent (Shute) 16 per cent adults 34 per cent children (Stone)

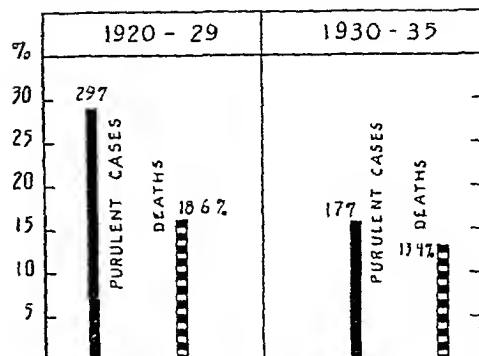


Chart 2 Mortality rates, 1920-1935—purulent cases

Some operators dislike a right rectus incision because they frequently have difficulty in locating the appendix. A most helpful maneuver is to insert the index finger of the left hand into the wound and extend it flexor surface upward until it touches the right anterior superior iliac spine. Then turn the finger over so that the flexor surface faces downward, and then follow down the side of the pelvis in the direction of McBurney's point. The tip of the finger will hook onto a longitudinal band, and the cecum can then be brought up easily into the operative field.

*Treatment of the stump* is varied and seems to make but little difference. Formerly all our cases were ligated and the stump inverted with a purse-string suture. Now inversion is seldom done except in gangrenous cases, and the results are as good. Also, it has made no difference whether the actual cautery or knife was used to sever the appendix, or whether the stump was treated with carbolic acid and alcohol or tincture of iodine.

*Drainage* is the most debated subject. Statistics show, and the majority opinion is, that it is used too much. A few men advocate its discontinuance in all cases, even the purulent

TABLE II—APPENDICITIS IN GOOD SAMARITAN HOSPITAL BY PERIODS

	No	Deaths	% Mortality	Average % for large hospitals
All types				
1920-1929	240	11	4.58	
1930-1935	430	9	2.09	3
Acute				
1920-1929	203	11	5.41	
1930-1935	399	9	2.25	5
Purulent				
1920-1929	59	11	18.6	
1930-1935	67	9	13.4	0

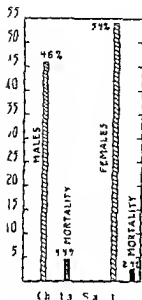


Chart 3. Mortality

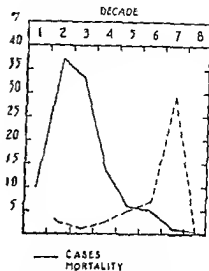


Chart 4. Percentage of Cases and Mortality

ones with diffuse peritonitis. This however seems too radical to us and to place too great a responsibility on the surgeon. In this series closure with drainage was used in all pus cases. Many borderline cases however in

TABLE III. APPENDICITIS IN GOOD SAMARITAN HOSPITAL 1930-1935

All cases	%	Deceased	Mortality	% of cases
Staff	83	3	5	6
Amateur	7	0	38	5
Staff	5	0	38	5
Amateur	5	0	38	5
Private	1	0	38	5
Staff	1	0	38	5
Amateur	1	0	38	5

TABLE IV.—SEX INCIDENCE

Acute	Sex-males	%	Deceased	Mortality	% of cases
Acute	53	5	8	5	6

TABLE V.—PERCENTAGE OF ACUTE CASES PER MONTH

Month	%
January	77
February	77
March	80
April	80
May	80
June	80
July	80
August	80
September	80
October	80
November	80
December	80

which drainage formerly was used are now closed without it and recover perfectly and although in years I have not used more than one small cigarette drain in any case regard less of the amount of pus and peritonitis present the results have been better than those in which more and larger drains were used.

Neostomy is a tickle friend but should never be forgotten. It works like magic in some cases and has no effect whatever in others. Three cases in this series however undoubtedly owe their recovery to its use. To be successful it must be employed before the small bowel is completely paralyzed. It is our belief that it should be used only as a secondary operation and be reserved for those patients in

TABLE VI.—WARD AND PRIVATE ROOM CASES SINCE 1931

Ward cases	%	Private room cases	%
Ward cases	9	Private room cases	28

TABLE VII.—RESULTS AS TO DECADES

Decade	Acute cases	Deceased	% of cases	% of deaths
Decade 1	5	6	2	2
Decade 2	3	4	2	2
Decade 3	7	5	2	2

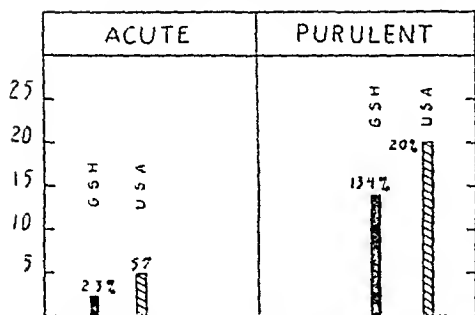


Chart 5 Mortality, 1930-1935, acute and purulent cases

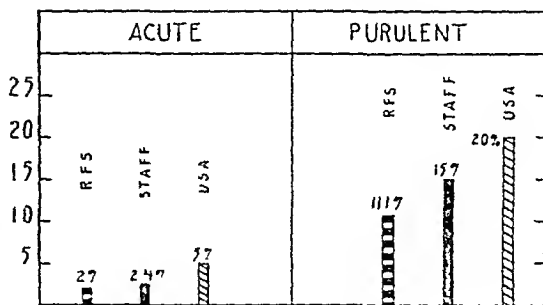


Chart 6 Mortality 1930-1935

which distention and ileus are not relieved by pitressin, hypertonic saline, or duodenal tube

*Cecostomy* was not used in any case in this series. Several writers, however, think it has real merit.

*Serotherapy* also was not tried in this series. Weinberg and Laquiere, however, report "the general mortality of 5 series of about 1000 cases of gangrenous appendicitis and peritonitis was 35 per cent without serum and 14 per cent with it" (16). Our mortality without its use in 123 similar cases, however, is only 15 per cent, so we are still undecided as to its value.

A few points in the *diagnosis*, operation, and postoperative care of appendicitis merit special mention. First, too much knowledge is probably the chief reason for a mistaken or delayed diagnosis. Paradoxical as this seems, the more conscientious the physician the more thoroughly he weighs the different possibilities, and the more often becomes confused. I have seen this happen many times. The greatest care must always be taken not to get sidetracked.

Incorrect temperatures are another cause of faulty diagnosis. This applies to rectal as well as oral readings. One of the deaths in this series was due to this error. The young man himself was permitted each time to insert the thermometer into his rectum, and this he failed to do sufficiently. As a result, his fever readings were negligible, and 48 hours delay ensued before the mistake was discovered.

Cases with sudden, abrupt onset or onset with diarrhea are practically never acute appendicitis.

*Treatment*, of course, is strictly surgical. Adequate incision should be made, a neat little scar often belies the undue amount of trauma it causes. The operator should be methodical, he should not mess, maul, or rush. Ether is the most satisfactory anesthetic, it was used in 95 per cent of the cases in this series.

*Postoperative care* is of paramount importance. It is here that the battle is so often lost in the purulent cases. It is here also that the small hospital can have a real advantage due to the fact that there are no internes, and each patient receives the personal attention of his surgeon all the time, and the supervision, check-up, and co-operation of the staff members can be so much more thorough and personal. Undoubtedly this accounts for our favorable statistics more than anything else.

The chief point in postoperative treatment we would emphasize is *always to keep the tongue moist*. A dry tongue is a danger signal. It takes but one second to discover, and yet is the only sure way to ascertain if the patient is receiving sufficient fluids. Watch the tongue constantly, it pays. Administer fluids orally, rectally, subcutaneously, or intravenously in sufficient quantity to make the tongue moist and to keep it that way as long as the patient is in the hospital.

Repeated transfusions of small amounts of whole blood are imperative in the weak or seriously sick patient. Our results with them have been highly satisfactory. Of late we have used the citrate method and find it simpler and easier for the patient, donor, and doctor, to be just as safe and successful as the direct method, and to cause no more reactions.

Another important although seemingly small item in the daily routine is to keep the patient's back covered. The combination of shirts that tie in the back and hospital beds with the blankets and sheets neatly folded at the patient's axillæ usually results in an uncovered back whenever he lies on his side. Many cases of postoperative colds and pneumonia undoubtedly develop in this way. Since this and even lesser details have been carefully checked in this hospital there has been an almost complete absence of these complications.

*Distention* besides being a sign of danger makes the patient most uncomfortable. Repeated small doses of morphine usually relieve it. Pitressin or pituitrin in conjunction with the rectal tube or gas enemas have also proved most useful. If these fail the duodenal tube should be employed. Seemingly slight differences in its use however make great differences in the results obtained. My procedure is to leave it *in situ* for 48 hours and to drain off the fluids every half hour then instill an ounce of a hypertonic saline solution clamp the tube until the half hour has again elapsed when the contents are again drained off and more saline instilled. The intravenous use of 30 cubic centimeters of 10 per cent saline solution at 3 hour intervals has relieved 2 cases in which all other measures had failed. We now use it in every obstinate case. If these efforts have not been successful ileostomy is now seriously considered and usually performed.

#### SUMMARY

An effort has been made to give a true picture of acute appendicitis in a small approved suburban hospital along with the author's opinion regarding the disease. Although this series is small it covers 16 consecutive years and is a fair cross-section of appendicitis in this locality.

The small well organized hospital has an inherent advantage over its larger brothers viz more personal contact with and constant attention to the patients by the staff members and not by internes. Every patient is in reality a private patient. Careful supervision and good co-operation are necessary however

to make this potential advantage a real one. This we have succeeded in doing for while my mortality since 1930 is 2.1 per cent for 147 acute cases that of the 6 other surgeons is 2.3 per cent in 252 cases or practically the same. Second better nursing can be given as these hospitals are too small to have training schools and consequently all the nurses are graduates.

The mortality for acute appendicitis in this series is 3.3 per cent and for the past 6 years only 2.2 per cent whereas for the United States in general it is 3 per cent. Indeed in New York City it is 7 per cent according to Kreh's analysis of 4,342 cases in 14 hospitals.

The mortality for purulent appendicitis in this series is 15 per cent while that for the United States in general is 20 per cent. Whereas 29 per cent of the cases were purulent up to 1930 only 17 per cent of them were since then an improvement of 41 per cent. This means earlier attention by the family, earlier recognition by the doctor, earlier hospitalization and earlier operation (Chart 2).

The mortality rate also has improved in these purulent cases viz 18½ per cent died before 1930 and only 13½ per cent since. This means improved surgical judgment and technique, improved nursing and postoperative care (Chart 2).

This study has proved both instructive and gratifying. The small hospital can do good work and keep up with the leaders. It can successfully handle the appendicitis problem.

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## THE DUPLICATION OF CONGENITAL MALFORMATIONS IN BROTHERS AND SISTERS AND AMONG OTHER RELATIVES

### A STUDY OF SIBLING DEFECTS IN FORTY CONSECUTIVE FAMILIES

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NORMALLY developed siblings (brothers and sisters) frequently resemble each other in appearance, and many families have been described in which brothers and sisters have exhibited *identical congenital deformities*. The latter families have been reported *individually*, and therefore have not formed part of a consecutive series, hence, they have not constituted a random sample of the population.

A study now being conducted by the author deals with a *consecutive* series of 884 families, in each of which there has appeared at least one congenitally malformed child (1). In 40 of these consecutive families, there were 2 or more malformed brothers and sisters.

In view of (a) the physical resemblances observed in normally developed brothers and sisters, (b) the frequent duplication of malformations in siblings, in families recorded in the literature, it is of interest to consider to what extent congenital malformations may duplicate among siblings born in families in a *consecutive* series. Our observations presented are upon such a group and are of interest, not only for this reason, but also in view of the seriousness of many of the defects in question.

The subject is of clinical as well as of scientific interest. If the *second* congenitally malformed child in a family is *more* likely to exhibit

the defect observed in its elder malformed sibling, than to have some other defect, such knowledge should be of interest to the obstetrician. For, if a pregnant, multiparous patient gives him any indication that her unborn child is not developing normally, knowledge of the type of defect observed in her previously born, malformed child, might assist him in predicting the nature of the defect, should she now be pregnant with another malformed offspring.

The present report deals with these considerations, and, in support of the latter, data are presented concerning the frequency with which congenital malformations duplicate in a series of 40 consecutive families. This material is supplemented by two additional groups of observations, the three sets of evidence being considered under the following headings: (1) the duplication of congenital malformations among siblings in 40 *consecutive* families, (2) the duplication of congenital malformations among siblings in 19 *non-consecutive* families, (3) the duplication of congenital malformations among other relatives of a *consecutive* series of families.

#### MATERIALS AND METHODS

To quote from a recent publication (2), the data forming the basis for subjects 1 and 3 were collected in the following manner:

## SURGERY GYNECOLOGY AND OBSTETRICS

TABLE I—PART I MALFORMATIONS AMONG SIBLINGS

Defect reported

Identifying number		Birth order								Defect diagnosed
Serial	Family	1	2	3	4	5	6	7	8	
	998	●	○	●	□	●	□	○		3 5 Anencephalus Hydrocephalus
	95	●	□	□	□	○	□	■		2 Gastroschisis Hydrocephalus
3	39	△	△	■	○	●	■			3 6 Hydrocephalus Anencephalus
4	3	○	●	△	●	□				Hydrocephalus
5	93	□	■	○	□	●				5 Hydrocephalus
6	53	●	●	○						Hydrocephalus
7	34	■	■							6 Anencephalus Hydrocephalus
8	2063	●	●	□	○	△	■			8 Anencephalus Hydrocephalus
9	4	●	□	□	●	□	●			Anencephalus
	43	●	■	○	○					5 Spina bifida
	54	△	□	△	■	●	□	○	●	6 Spina bifida
	90	△	●	△						Spina bifida
3	938	△	■							5 Extrauterine fetus
	5	□	■	□	△	●	□			6 Extrauterine fetus Intrauterine
5	90	□	●	□	△	●	■			7 Pylorectomy
6	59	●	□	○	□	□	□	■		Pylorectomy
7	7	■	■	■						6 Stillborn fetus Intrauterine
8	5	○	●	○	○	○	●	■	○	Heart defect
9	7	△	△	●	■					Cleft palate
	6	●	□	△	●	○	△			Hiatal hernia
	994	●	△	□	■	○	□			Malnutrition
	3	△	△	△	■					3 Fetal death
3	605	■	○	■						

□ Malnutrition  
■ Defect

○ Normal  
● Defect  
△ Twin

△ Sex unknown  
■ Miscarriage

Table I. A tabulation of the defects of children, (b) family tally, malformed children, each of the first 23 families. The families have been listed in the order of the number of malformed children. The defects are listed in the first column. The number of children in each family is listed in the second column. The symbols used are: □ Malnutrition, ■ Defect, ○ Normal, ● Defect, △ Twin, △ Sex unknown, ■ Miscarriage.



mother who could be located. The group forms a consecutive series. The defective children all died within a given geographical area and in a given period of time.

Announcements concerning the study forming the basis for subjects 1 and 3 were made in the majority of medical journals published in the United States and in Canada. These announcements requested correspondence from physicians who had observed congenital malformations in *two or more brothers or sisters*. The data resulting from this correspondence are presented under subject 2.

#### DUPLICATION OF CONGENITAL MALFORMATIONS AMONG SIBLINGS IN 40 CONSECUTIVE FAMILIES

In the consecutive series of 40 families with 2 or more malformed siblings, 29 each contained 2 and the remaining 11 families each possessed 3 malformed siblings. Data concerning (a) birth order of defective children (b) family size (c) sex of each child (d) incidence of miscarriages including abortions and (e) the chief diagnoses of the malformed individuals in each family are given in Table I, Parts 1 and 2. The majority of the malformed children each exhibited a single serious congenital malformation, though a few suffered from two or more such defects. In order to simplify the handling of the material, each of the latter children was assigned a single diagnosis. This was selected in the following manner: In case 2 defects were present in a child, that malformation was assigned to it which also was observed in its sibling. In cases in which siblings had multiple defects which did not duplicate, each child was assigned its most serious malformation as its diagnosis.

After this was done, the families were arranged in three groups as shown in Table I, Parts 1 and 2. The first group of 23 families (Table I, Part 1) includes those in which the defect duplicated, though the repeating defect did not always reappear in the first subsequent defective child. The 15 families forming group 2 (Numbers 24 to 38 inclusive—Table I, Part 2) possessed children having defects which repeated in the case of the families in group 1, but these defects did not repeat in subsequent siblings in the families in group 2.

In the last group of two families forming group 3 (Table I, Part 2), defects appeared which did not occur in either group 1 or group 2.

*Frequency of repetition of malformations.* From the above arrangement, it will be observed that 23 of the 40 families, or 57.5 per cent, exhibited the same defect in two siblings. It is evident also that practically all of the remaining families, except the 2 in group 3, possessed defects which did repeat in group 1.

The fact that some of the families with recurring defects contained 3 instead of only 2 malformed siblings, and the added fact that in these families with 3 malformed children the repeating defect did not always reappear in the second malformed child, necessitated a statistical evaluation of the frequency of defects by individual chances, as well as by family frequency.

This computation was carried out in the following manner. In each family with only two malformed members, there naturally existed only one chance that the malformation would repeat. However, in families possessing three malformed children, there existed three chances that such a defect might recur. For example, in the case of family 1 in Table I, there were two chances that the defect occurring in the first defective child would repeat, i.e., either in child 3 or in child 5. In the case of the second defective child (No. 3) in this family, there was naturally only one chance that this defect would reappear. This method gave a total of 62 chances that a defect could or could not recur. By this computation, it is found that the defect occurred in 29 out of 62 chances, or in approximately 46.8 per cent of instances, and that it did not recur in the remaining 33 chances, or in 53.2 per cent of cases.

The frequency of occurrence of all of the defects listed in Table I was compared with the frequency of the same defects if they were observed in the total of 890 consecutive congenitally malformed individuals for whom death certificates were available. It was found that the proportion of the different defects was approximately the same in each of the two groups, thus indicating that in all probability we were dealing with an adequate number of families.



TABLE II—MALFORMATIONS AMONG SIBLINGS

Repetition of defect

Serial number	Physician	Birth order								Defect diagnosed
		1	2	3	4	5	6	7	8	
1	C. E. Caswell	□	○	○	△	●	○	44 11	●	5 7 Spina Bifida
	L. A. Miller	●	■	□	■	●				1 2 4 5 Hand deformities
3	L. A. Miller	○	■	●	●	■				2 3 4 5 Spastic paraplegia
4	W. C. Brinkman	●	□	□	■					1 4 Club-foot
5	G. C. Macrae	●	●	□	■					1 4 Harelip cleft palate Feeble-minded
6	Anonymous	●	□	■	○					1 3 Cleft palate
7	C. F. J. Dodge	■	○	■						1 3 Congenital myopia
8	W. B. Serlin G. N. Krost	△	●	■						3 Absence of right thumb
9	J. W. Christie	●	■							2 Club-foot mono- Club-foot
10	M. Lippmann	■	■							1 2 Harelip cleft palate
11	I. P. Bronstein	○	■	○	■	□	○	□		2 Crani- 4 Abnormalities
12	J. P. Greenhill	△	△	▲	▲					3 Hydrocephalus 4 Anencephalus
13	J. P. Greenhill	▲	▲	△						1 Hydrocephalus 2 Anencephalus
14	C. T. J. Dodge	■	○	■						1 Epilepsy 3 Faulty development of brain
15	F. F. Smith	△	■	●						1 Harelip cleft palate 3 Polio
16	W. Z. Bradford	▲	▲							1 Congenital club-foot 2 Marfan's syndrome 3 Eyes + ears
17	J. W. Christie	■	■							1 Hydrocephalus 2 Absence of right eye
18	F. I. Turt	●	●							1 Harelip cleft palate 2 Anencephalus
19	W. B. Serlin	●	●							1 Congenital Club-foot



Normal } Male  
Defective }



Normal } Female  
Defective }

Sex unknown  
Miscellaneous

Defect in fetus

44 Twin

Table II shows (a) birth order of congenitally malformed children, (b) family size, (c) sex of child, (d) type of malformation, (e) timing of abortions, and (f) the chief diagnosis of each congenitally malformed child. In each case, the first two sibs, at least, are reported by correspondence. Murphy cases. No other cases of congenital malformations in the first 10 families.



Data dealing with the frequency with which the defects observed in the certificate children, duplicated in malformed relatives, are summarized in Table III. Column 1 records the defects observed in the certificate children, arranged in order of their frequency. Column 3 gives the number of instances in which the defect in the relative duplicated that seen in the certificate child. The totals given at the bottom of this table indicate that the defects noted in the certificate children reappeared in their respective relatives in 16 instances of a possible 39, or in approximately 41 per cent of cases. This high incidence of the duplication of congenital malformations supports the theory that these malformations are more or less expressions of family tendencies.

Of the 39 families with one or more congenitally malformed children, whose relatives also presented congenital malformations, 20 families had defective relatives on the mother's side and 19 families on the father's side. In the case of the 20 families on the mother's side, the defect was found duplicated in 12 instances whereas in the case of the 19 families on the father's side, the defect duplicated in only 4 instances.

The relationships of the defective relatives to the certificate children, irrespective of whether they belonged to the mothers or to the fathers, are recorded in Table IV. Since the figures in this table are small, they have little if any statistical significance, but are presented for what they may be worth.

#### CLINICAL VALUE OF STUDY

It is evident from the above data that there is a strong tendency for congenital malformations to duplicate in siblings that belong to a consecutive series of families. And also, that such defects tend to appear rather frequently among their more distant relatives. This duplication of malformations is to be observed in the case of the more serious types of defects, just as it is noticed in the less serious ones. These findings lend support to the theory that congenital malformations are primarily the result of influences which affect the germ cells prior to rather than after, fertilization. The validity of this theory is emphasized by three examples taken from Tables I and II. Family

17 in Table I contained 3 children with pyloric stenosis, two of which were twins. Family 6 in Table II possessed 2 siblings with cleft palate, conceived by the same father, but born to different mothers. Family 8 in Table II contained 2 children both exhibiting an absence of the right half of the diaphragm. It does not seem likely that such sequences of events as these could be the result of any forces that did not operate until after fertilization had taken place.

There is also a practical lesson to be drawn from the present observations. If the second malformed child is so extremely likely to have the same defect as the first malformed child—the obstetrician, knowing this, is in a better position to predict the nature of the defect that he may suspect in an unborn child of a patient who has already given birth to one defective offspring. Likewise, following the birth of a malformed child, he may be able to give the parents some idea of what type of defect might be expected, should they continue to reproduce, and have a second malformed child.

Since, as has been shown in a previous report, congenital malformations are 24 times more common in siblings of defective children, than in the population at large (1), the present observations should be of added clinical interest.

#### SUMMARY AND CONCLUSIONS

1. A *consecutive* series of 40 families having 2 or more congenitally malformed children has been studied with respect to the duplication of defects in siblings.

2. The defect observed in the first malformed child reappeared in a subsequent malformed sibling in *about* 50 per cent of all cases, the 50 per cent remaining including all other possible defects.

3. In a second group of 39 *consecutive* families, in which a malformed child possessed a malformed relative, the malformation in the child and in the relative were identical in about 41 per cent of cases.

4. In 19 *non-consecutive* families with 2 or more malformed children, the defect of the first child repeated in a subsequent child in over half of the families.

5 From this analysis and from previous studies it is concluded

a That many if not most of the congenital malformations met with in this study resulted from defects in the germ plasma which were present before fertilization

b That when a congenital malformation is suspected in an unborn fetus the obstetrician will do well to investigate the family history and the parents' previous reproductive history for the existence of other defective members—

which information not only may confirm his suspicion that the fetus is malformed but also may aid him in recognizing the type of defect that is present

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# CLINICAL STUDIES ON THE INFLUENCE OF CERTAIN DRUGS IN RELATION TO BILIARY PAIN AND TO THE VARIATIONS IN INTRABILIARY PRESSURE

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THE problem of pain which in some cases recurs following cholecystectomy led us to investigate the action of drugs on the common bile duct. We previously have demonstrated that the pain is associated with an increase in pressure within the common bile duct (3, 6). With this in view, we have determined the action of some of the common drugs on the mechanism which produces this increase in pressure.

## REVIEW OF THE LITERATURE

We have not found any reports on the direct measurement of intrabiliary pressure of human beings. There are numerous accounts of the action of various drugs on the biliary system of animals, some of which will be mentioned because they pertain to drugs which we have used.

Kitakoji found that preparations which excite the parasympathetic nerves also stimulate the tonus of the sphincter of Oddi, both *in vivo* and *in vitro*. He found that muscarine, pilocarpine, physostigmine, and especially acetylcholine produce this action. Atropine and scopolamine paralyze the parasympathetic nerves and relax the tonus of the sphincter of Oddi. Epinephrine and ergotamine tartrate produce slight change or no change in the intrabiliary pressure. He demonstrated that morphine and nicotine cause a contraction of Oddi's muscle.

Shi confirmed Kitakoji's work, and, in addition, demonstrated that pituitrin relaxes the sphincter of Oddi. Giordano and Mann said that if solutions of alkalis were placed in the duodenum they increased the resistance of the sphincter of Oddi and if acids were placed in the duodenum they decreased the resistance of the sphincter. Burget obtained essentially the same results.

Bliss suggested that in the treatment of postcholecystectomy colic 0.06 gram of papaverine in 10 cubic centimeters of water should be administered through a duodenal tube in order to relax the muscle of the sphincter. A solution of magnesium sulphate should then be placed in the duodenum in order to cause a flow of bile.

## METHOD

Patients who had been subjected to an exploration of the common bile duct and who had had a T tube inserted into the common bile duct for prolonged biliary drainage kindly consented to serve as the subjects of these observations. The apparatus used has been described before (5). The apparatus consisted briefly of a water manometer which was connected to the T tube at the level of the subject's abdominal wall. A bottle, which was fastened high enough to act as a reservoir, was connected with the system in order to fill it with sterile physiologic saline solution and to provide a source of supply when it is desired to perfuse the common bile duct with a quantity of this solution. Thus, two readings were obtained: (1) that for the intrabiliary pressure, which is obtained by observing the height at which fluid will stand in the manometer, and (2) that for the perfusion pressure, which is obtained by observing the height at which the fluid must be raised in the manometer in order that the resistance of the sphincter at the lower end of the common bile duct may be overcome and the fluid may flow into the duodenum. For the purpose of obtaining permanent records a U-shaped manometer that contained a float and writing point which contacted a smoked drum was substituted for the water manometer. Roentgenograms of the common bile duct, which are made after the injection of an opaque oil (brominol), afford a

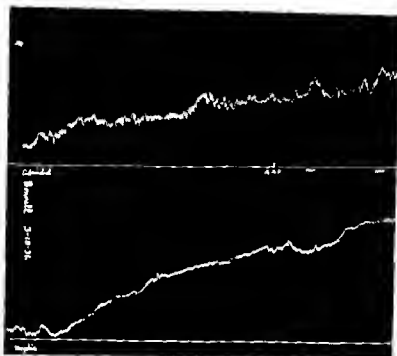


Fig 1. Increased intrabiliary pressure following injection of 0.02 gram of dilaudid below the injection of 0.02 gram of morphine sulphate.

further method of studying the mode of action of the drugs used

#### DRUGS WHICH PRODUCE A SPASMODIC CONTRACTION AT THE LOWER END OF THE COMMON BILE DUCT

The first observation of significance was that subcutaneous injection of  $1/6$  gram (0.01 gm) of morphine sulphate caused an increase in the intrabiliary pressure from the normal of from 0 to 20 millimeters of water to 200 to 300 millimeters of water. This elevation of pressure began from  $2\frac{1}{2}$  to 5 minutes after the injection of the morphine and reached its maximum in 15 minutes. Concomitant with this rise in pressure the patient may experience an attack of biliary colic. In other cases there may be no pain but only a sense of epigastric tightness and fullness. The injection of morphine frequently will produce an increase in intrabiliary pressure without evoking pain. The pain which originates in the epigastrium and right upper quadrant of

the abdomen and extends to the right subscapular region has been found to follow the administration of morphine only in cases in which patients seek relief because of the postcholecystectomy syndrome. Following the administration of morphine the value for the perfusion pressure also was elevated from a normal of from 150 to 200 millimeters of water to 400 to 450 millimeters of water.

Injection of  $1/4$  grain (0.02 gm) of pantopon  $1/32$  grain (0.002 gm) of dilaudid or 1 grain (0.065 gm) of codeine produced an elevation of both the intrabiliary pressure and the perfusion pressure but the elevation was neither so swiftly produced nor so high as that which follows the injection of morphine (Fig 1).

The means by which these drugs cause an elevation of the intrabiliary pressure and delay in the emptying of the common bile duct is well shown by roentgenograms. The roentgenograms of the common bile duct which are shown in Figure 2 were made before and after

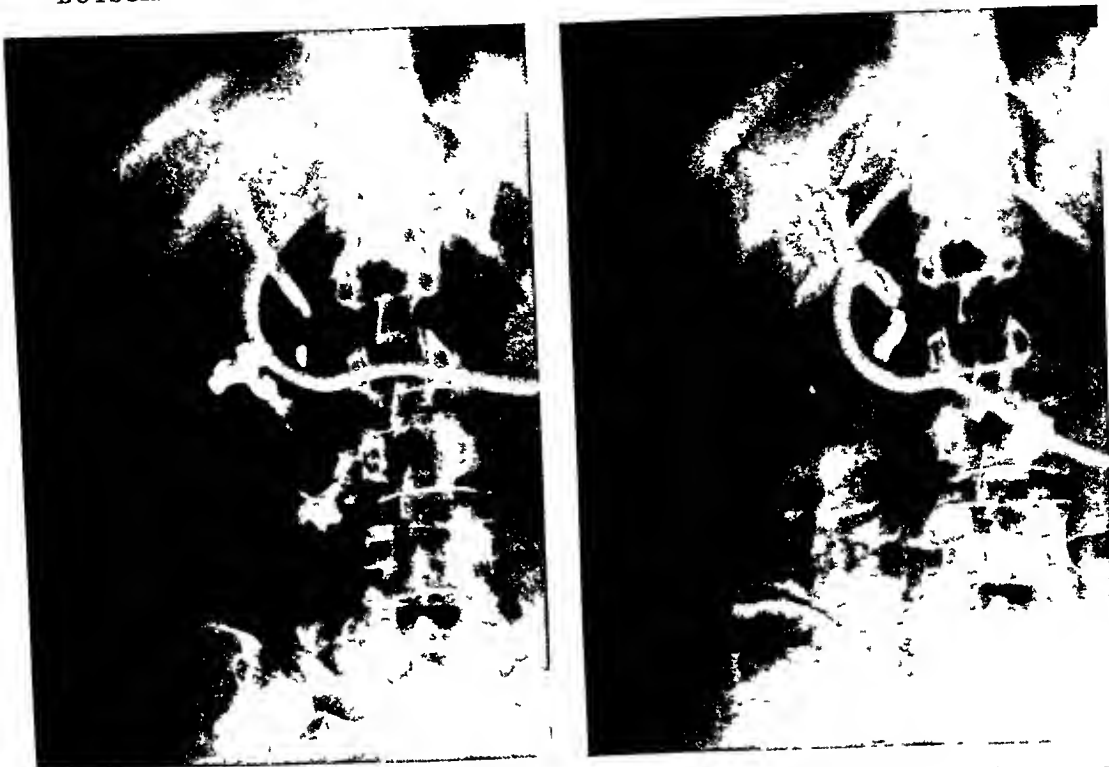


Fig 2 Common bile duct, left, before administration of morphine, right, after subcutaneous injection of 0.01 gram of morphine sulphate

the administration of  $1/6$  grain (0.01 gm) of morphine. The sharp constriction of the lower end of the common bile duct effectually prevented the emptying of the duct. This blocking of the common bile duct dammed back the media and caused it to enter the hepatic ducts (Fig 2).

The effect of morphine on the common bile duct is a prolonged one. The pressure in the common bile duct may remain elevated 2 hours or more following the administration of this drug.

#### DRUGS WHICH RELAX SPASMODIC CONSTRICTION AT THE LOWER END OF THE COMMON BILE DUCT

Inhalation of amyl nitrite produced an immediate and dramatic decrease of the elevated intrabiliary pressure to zero. Simultaneously with this fall there was a prompt relief of the pain or of the feeling of fullness which accompanied the elevated pressure. Inhalation of

amyl nitrite will instantly lower the elevated intrabiliary pressure, whether it is spontaneous or the result of injections of morphine. In the latter case, the relaxation produced by inhalation of amyl nitrite is prompt but immediately afterward the pressure begins to increase slowly until it reaches its former level. This is the result of the prolonged action of morphine (Fig 3).

Administration of glyceryl trinitrate in doses of  $1/100$  grain (0.0006 gm) produced a decrease in the elevated pressure, which was less marked but more lasting than that which was produced by inhalation of amyl nitrite, but if the elevation in pressure was the result of injection of morphine, it again increased to its former height. As glyceryl trinitrate produces a more lasting decrease in the pressure than does inhalation of amyl nitrite, the former drug is of more value for therapeutic purposes. It is effective when placed under the tongue.

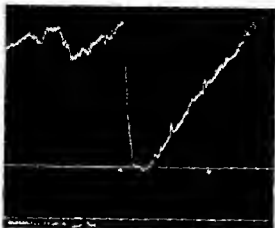


Fig. 5. Effect of inhalation of amyl nitrite on elevated intrabiliary pressure caused by injection of morphine sulfate.

Intravenous administration of 4 grains (0.24 gm.) of theophylline ethylenediamine produced a relaxation of the sphincteric mechanism similar to that produced by inhalations of amyl nitrite. Figure 4 shows a comparison of the actions of theophylline ethylenediamine and glyceryl trinitrate on the elevated intrabiliary pressure of an individual who previously had received 1 grain (0.065 gm.) of codeine hypodermically.

The roentgenograms of the common bile duct show very graphically how inhalation of amyl nitrite relaxed the spasm at the lower

end of the common bile duct which morphine produced and how the former drug caused emptying of the hepatic and common bile ducts (Fig. 5).

#### THE ACTION OF OTHER ANTISPASMODIC DRUGS

Other drugs which generally are believed to have an antispasmodic action were tested for the effect on the sphincteric spasm caused by injection of morphine. The drug to be tested was first injected so as to be sure that it did not elevate the intrabiliary pressure. Then 1/8 grain (0.01 gm.) of morphine was injected and a few minutes later after the elevation of pressure produced by the morphine had reached its maximal height another dose of the drug to be tested was given. In this manner it was found that injection of 1/75 grain (0.0009 gm.) of atropine produced dilatation of the pupils and dryness of the mouth but did not relax the sphincteric spasm caused by the injection of the morphine. An injection of 1/100 grain (0.0006 gm.) of hyosine hydrobromide did not have any effect on the spasm of the sphincter (Fig. 6).

Other drug which have been prescribed because of their ability to relax spasm of other muscular organs were administered in order to determine whether they would lower the intrabiliary pressure produced by injections of morphine. Forty milligrams of muscle adenine phosphate and 30 cubic centimeters of

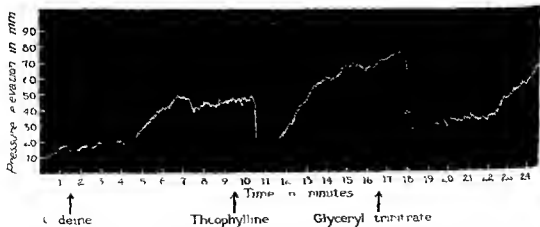


Fig. 4. Comparison of the effects of glyceryl trinitrate and theophylline ethylenediamine on the elevated intrabiliary pressure.





Fig 5 left, Spasm of lower end of common bile duct following injection of 0.01 gram of morphine sulphate, right, relief of spasm by inhalation of amyl nitrite

alcohol, 0.6 milligrams of histamine,  $\frac{3}{4}$  grain (0.05 gm) of ephedrine, and 1 cubic centimeter of a 1:1000 solution of epinephrine did not have any effect on the pressure in the common bile duct when they were administered subcutaneously at different times. Intravenous administration of 10 cubic centimeters of a 10 per cent solution of calcium chloride also failed to lower the pressure. No decrease in the pressure was noted after the intravenous administration of  $\frac{1}{2}$  grain (0.032 gm) of papaverine hydrochloride or after the intramuscular administration of 3 grains of the same drug.

Of the parasympathomimetic drugs, both physostigmine and acetylcholine were tested, but no effect on the intrabiliary pressure was noted. The synergistic action of these two drugs was recognized and they were administered in combination, that is, 100 milligrams

of acetylcholine was given 20 minutes after the administration of  $\frac{1}{25}$  grain (0.0026 gm) of physostigmine, but no further effect was noted.

Administration of 0.5 cubic centimeter of a 1:2000 solution of ergotamine tartrate,  $7\frac{1}{2}$  grains (0.5 gm) of caffeine, and 2 grains (0.12 gm) of luminal sodium, at different times, likewise, produced no effect. All of these drugs were administered hypodermically unless otherwise stated.

#### COMMENT

The pharmacology related to the sphincteric mechanism at the lower end of the common bile duct raises many questions which have not been answered. An analgesic drug or combination of drugs is needed, which can be administered to patients who have undergone cholecystectomy, and which will not raise the intrabiliary pressure. Morphine will raise the



Fig. 6. Effect of injection of 0.0006 g. m. of hyoscine hydrobromide on intrabiliary pressure caused by injection of morphine.

pressure in the common bile duct to 300 milligrams of water which is equivalent to the secretory pressure of the liver. Thus morphine would not be a good drug to administer after operation to a patient who has a low liver reserve. For the same reason a drug which elevates intrabiliary pressure should be used with caution in cases of biliary fistula or in cases in which the occurrence of a biliary fistula is feared.

These observations are of necessity limited because the subjects were human beings. In such a situation only the recognized doses of the drugs may be given. We did not feel justified in determining whether larger doses of some of the drugs would be effective.

The nitrites are very effective clinically both in reducing an elevated intrabiliary pressure and in relieving the accompanying pain. Thus far we have been able to obtain complete relief clinically in a series of 12 cases of postcholecystectomy colic by use of glyceryl trinitrate. There has not been sufficient opportunity to observe the action of theophylline ethylenediamine clinically. It is significant that all the alkaloids of opium commonly used as analgesics cause a rise in intrabiliary pressure and may actually prolong the pain for which they are given.

#### SUMMARY

Morphine, codeine, and dihydromorphone produce a marked increase in the pressure within the common bile duct because they produce a spasm in the sphincter at the lower end of the duct. Amyl nitrite, glyceryl trinitrate, and theophylline ethylenediamine will completely relax the sphincteric spasm and thus produce a fall in the pressure. Certain other drugs which have been tested do not have any effect on the pressure within the common bile duct.

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## THREE HUNDRED MIXED TUMORS OF THE SALIVARY GLANDS, OF WHICH SIXTY-NINE RECURRED

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THIS is the fourth in an unnumbered series of studies upon salivary gland tumors that have occupied much of my time during the last 10 years, and in order that the reader may derive the greatest profit from it, it may be wise briefly to review the contents of its predecessors.

Between 1920 and 1925 I became convinced that correct understanding of the nature and disposition of tumors is not to be arrived at from the study of the statements of surgeons whose case reports published a few weeks after the performance of the operation usually terminate with the optimistic assertion that the patient "made a good recovery" and "the tumor shows no sign of recurrence."

Nor is it to be derived through painstaking histopathological study of bits of tissue removed by biopsy, or of whole tumors removed surgically, or even from the more extensive study of the lesions discovered at a necropsy.

The complaisance of the surgeon is not infrequently disturbed by the return of his patient with a recurrence of the tumor, and that or the pathologist, by the continued good health of some patient condemned to death upon the histopathological evidence of a supposed malignancy.

Convenient means are ready at hand for smoothing out these distressing paradoxes, for if the supposedly innocent tumor recurs, it may be from some scrap of tissue insulted by the operative trauma, that escaped the vigilance of the operator and was left behind to "change its disposition" and "become malignant." On the other hand, if the tumor pronounced by the pathologist to be malignant, is never seen again, it may be but proof of the exceptional skill and thoroughness of the surgeon who successfully eradicated every vestige of it!

There is little reliable information concerning tumors of any kind. The existing data regarding their etiology, taxonomy, diagnosis,

and prognosis are very imperfect, with the unfortunate consequence that the treatment is also imperfect and often without scientific foundation.

To understand tumors, it is necessary to know all about them, to study large numbers brought together in groups, and to correlate the pathological findings with the clinical data, not only up to the time of operation, but *thereafter so long as the patient lives*.

The mixed tumors of the salivary glands are among those most prone to behave in an unexpected manner. My own past experiences with them led me into some embarrassing prognostic blunders and made me realize the necessity for additional knowledge.

To that end I set about collecting all of the mixed tumors I could get from every source possible. I began by visiting the laboratories of hospitals whose pathologists were my friends, and through their generous co-operation was permitted to examine the microscopic sections of such salivary gland tumors as had collected in each.<sup>1</sup>

Having studied the slides I next sought out the case histories from which more or less data concerning the tumors up to the time of their operative removal were usually available. The postoperative history of many of the tumors was later obtained by correspondence with the surgeons or with the patients themselves. My material came from a total of 27 hospitals where it represented the work of 90 surgeons, the total number of tumors collected to date (January, 1936) being 301. One half of the material—148 cases, was obtained from the University, Lankenau, and Jefferson Hospitals in Philadelphia. The largest number of cases—56—was from the Jefferson Hospital. When it is said that the 148 cases collected in these three hospitals represented all of the recorded cases of mixed tumors of the salivary

<sup>1</sup>I met with invariable courtesy and was afforded every opportunity to pursue my purpose and for their friendly assistance I here desire to express my sincere appreciation and thanks.

## SURGERY GYNECOLOGY AND OBSTETRICS

glands treated in those hospitals during the course of a quarter of a century it will be seen that there were very few cases a year in each. Many small hospitals have never had but 1 or 2 cases each.

When in 1925 the number of collected cases reached 90 and I had found out by correspondence what had happened to those who had not died or moved away so that it was no longer possible to find them I published the results of my investigation in 1926 in a paper entitled "Ninety Tumors of the Parotid Region in All of Which the Postoperative History Was Traced."

The paper began with a review of the theories regarding the origin and nature of mixed tumors after which my cases were tabulated and arranged in many combinations by which a number of interesting facts that had escaped previous authors were brought out. Some of the conclusions at which I arrived were:

Mixed tumor are inherently benign but commonly recur after excision and if frequently disturbed become locally destructive and invasive without giving metastasis.

The histology of mixed tumors is extremely complex but on that account their microscopic diagnosis is usually easy.

The immaturity, atypical arrangement and confused intermingling of the various tissue components easily lead to misinterpretations as to their nature and to mistakes as to their disposition.

Histological variation among mixed tumors have no bearing upon prognosis. The microscopic beyond showing that the lesion is a mixed tumor is misleading.

The rapid enlargement of a mixed tumor of long duration and slow growth is not the result of malignant change.

Malignant change whether sarcomatous or carcinomatous in mixed tumors must be very rare and its recurrence difficult to prove.

An interval of 10 or even 30 years may elapse between the operative removal of a mixed tumor and its recurrence. Caution should be exercised in declaring any case to be curable.

In the meantime I devoted considerable attention to the study of a tumor that seemed

to merit especial attention. It appeared in my first paper as Case 90 was called an adenoma and was placed at the very end of the list because of uncertainty as to its histopathological diagnosis. I published in 1927 a full description of it together with a discussion of the tumors called adenomas of the salivary glands collected from the literature in a second paper entitled "Adenoma of the Salivary Glands with the Report of a Possible Case."

Subsequent events fully justified its original classification as a mixed tumor. I have succeeded in maintaining correspondence with the patient from whom it was removed for more than 10 years. He is now over 80 years old but wrote June 14, 1935 to tell me that he now has a recurrence the size of a hazel nut. As the pre-operative duration of the tumor is given as 3 years and the postoperative interval before recurrence was 10 to 12 years it is of course fully in accord with the clinical course fully accords with the diagnosis of mixed tumor though its histology was unusual.

My interest in the subject both continued and increased. I visited more hospitals and collected additional cases until at the end of another 4 years (1931) their number had risen to 135 and some new facts had been determined that seemed to merit another publication.

The third paper "Tumor of the Parotid Region: Studies of One Hundred and Thirty-five Cases" appeared in 1933.

Among the conclusions with which it ended the following may be worth reiteration.

After the excision of any type of parotid tumor recurrence may take place at any time up to 30 years. This makes it difficult to be certain that any case is cured. It also makes it certain that the tumor are malignant in themselves and not by virtue of any sarcomatous or carcinomatous degeneration.

Except in the rarest cases there is no metastasis so that the type of malignancy is peculiar.

The mixed tumors have a fairly regular rate of growth that is ordinarily very slow. Occasional tumor of rapid growth are not necessarily more dangerous than others.

When growth is so rapid as to bring the patient



The third paper contained 45 new cases that have now been on the list for an additional 5 years of these it has been possible to keep in touch with 21. What has happened to them is worth noting

Two of the 45 cases were followed up for 5 years. One of these was a case of carcinoma of the parotid gland which was removed at the first operation. The patient was a girl of only 11 years of age. The ex-

cised lesion was accompanied by what seemed to be a lymph node that contained a small cellular area at first thought to be a carcinoma metastasis. This was at first thought to be a positive confirmation of the diagnosis of carcinoma, but later when the matter became one of particular interest it was examined by several competent pathologists and came to be looked upon as a mixed tumor nodule instead. Tissues from the recurrences removed at subsequent operations were entirely different most of them being composed of regularly formed orderly glandular tubules with semi columnar epithelial linings with goblet cells. Within a year the patient now 16 years old well developed and well nourished has had one after the other three pea sized superficial recurrences very soft and cystic the microscopic structure of which was that of the very soft myxoid variety of mixed tumor.

In Case 56 the later recurrences seemed to become more and more cellular with an atypical arrangement of cells in columns that might be interpreted to mean carcinoma but the patient died of the tumor without any signs of metastasis (no necropsy was performed).

Case 116 had a tumor that grew to the size of a grapefruit in 7 years. It was never treated and she died of ulceration and infection. After death a necropsy was performed and the tumor and its surroundings were carefully studied. Parts of the tumor were dense chondroid and acellular other parts were extremely cellular and quite typical of carcinoma. The necropsy operator found lymph nodes enlarged by typical carcinoma metastasis.

Case 70 was twice operated upon for a tumor that I classed as carcinoma but is now living without recurrence and in perfect health 11 years after the second operation.

It would be possible to cite additional cases but it seems unnecessary for the only conclusion at which it seems possible to arrive is that the histological structure of the tumor is not such as to indicate whether it will recur how frequently it will recur or how it will terminate.

#### RECURRENCE IN MIXED TUMORS OF THE SALIVARY GLANDS

Among the 301 tumors of the salivary glands in this series are 2 neurofibromas and 2 angiomas. As their relation to the mixed tumors is problematical they will be omitted from the present consideration.

There are 97 tumors of which 69 or 71 per cent have recurred. Of the 301 tumors 78 or 93.6 per cent were of the parotid glands or 6.1 per cent were of the submaxillary glands 1 or 0.3 per cent were of the sublingual glands.

Of the 278 tumors of the parotid glands 60 or 21.5 per cent recurred of the 22 tumors of the submaxillary glands 8 or 36 per cent recurred the one tumor of the sublingual gland or 100 per cent recurred.

So far as the microscopic studies are concerned continued disappointment persists. There seems to be no type of structure that can be relied upon for prognostication. Typical mixed tumors of hard chondroid and of soft myxoid types recurred with about equal frequency, sometimes again and again and caused death. Tumors of sarcomatous and carcinomatous appearance for which a bad prognosis was made did not recur as expected. In general the histological appearance of the recurrence resembled that of the primary tumor but there were notable exceptions. In Case 115 the diagnosis made from the microscopic examination of the tissue removed at the first operation was carcinoma in spite of the fact that the patient was a girl of only 11 years of age. The ex-

The most recent and most elaborate histological studies of the tumors of the salivary glands are to be found in the "Essai de classification architecturale des tumeurs des glandes salivaires," by R. Leroux and J. Leroux-Robert (1). The authors were more interested in the histology and histogenesis of the tumors than in their benign or malignant disposition, and after the study of 102 cases created 17 different categories into which to divide them. Their numerous and excellent illustrations make their contribution a beautiful atlas of the histopathology of the tumors, which they believe originate as "epitheliomas" of the gland itself. They promise a future publication dealing with the clinical behavior of the tumors in each class, but when the vagaries of the tumors are considered, one cannot but feel that an average of about 6 tumors to a class scarcely permits much expectation of success.

There are several questions about mixed tumors, frequently asked, but very difficult to answer. The first is, "Are the mixed tumors benign or malignant?" How difficult this is to answer may be inferred by my own attitude. In my first paper it is stated that "they are inherently benign" and in the third paper that "the tumors are malignant in themselves, and not by virtue of any sarcomatous or carcinomatous 'degeneration'." Is this a contradiction?

The differences separating other benign and malignant tumors are rarely clear cut. There are certain tumors made up of tissues of adult type and of specialized cells that are always classified as benign, and others composed of unripe or embryonal cells whose vegetation seems to be too rapid to permit of specialization, that are always classified as malignant. But there seem to be still other tumors whose cells may behave in either manner, and may even do first one then the other. A leiomyoma, for example may for a long time grow slowly, the cells presenting the usual characteristics of the smooth muscle, and then, beginning at some localized point, the cells begin to vegetate, losing the usual specialization, while the tumor assumes a malignant character with metastatic dissemination. Is the leiomyoma benign or malignant?

Peculiar, usually small tumors, first encountered in the vermitorm appendix, were, because of their histology regarded as carcinomas, but as they occurred only in the young and showed no evidence of a malignant tendency, came to be recognized as benign, and regarded as a kind of nevus. They were called "carcinoids" until it was later found that the essential cells are argentophilic, are probably identical with the Kultschitzky cells and very probably of neuro-ectodermal origin, when the name was changed to "argentaffinoma." They were still for some years regarded as benign, until it was discovered that some of them became invasive, destructive, and metastatic. Is the argentaffinoma a benign or malignant tumor?

Much the same is true of the "mixed tumors" of the salivary glands. Most of them grow slowly and steadily for many years without invasion or metastasis. Others appear quickly, grow rapidly, recur again and again after surgical excision, invade the surrounding structures, eventually destroying life by ulceration, hemorrhage, or infection, and in very rare instances metastasize.

If undisturbed, they may simply become large and even massive tumors. The largest in our series weighed  $11\frac{1}{2}$  pounds, the largest on record, Contrill's case, 26 pounds. Are they benign or malignant? Perhaps the difficulty would be overcome if they were spoken of as "potentially malignant tumors."

Many believe that the tumors "become malignant," i.e., transform into a new type of tumor either sarcoma or carcinoma, an old idea based upon the assumption that there are only two malignant tumors, sarcoma and carcinoma. There is no change in the tumors except in the rapidity of their growth. They do not behave as carcinomas, for of 297 of these tumors, of which 69 were recurrent and 8 were fatal, only 3 are thought to have been attended by metastasis to the lymph nodes of the neck and only 1 by metastasis in the lung.

To excise every tumor possible as early as possible, is, in general, sound doctrine, for every tumor seems to contain potentialities for harm that may develop at any time, and under ordinary circumstances it must be more

easy and less disturbing to remove a small tumor than a large one. It was because the surgeon acted upon this principle that most of our 301 tumors were removed and thus brought under investigation. But whether this principle applies in all cases is not sure and there is reason to believe that with respect to the mixed tumors of the salivary glands it is a mistake.

In my third paper I showed by the tabulation of those cases for which the necessary data were at hand that the average tumor grows regularly and slowly so as to attain the size of a walnut in about 10 years and an orange or grapefruit in 20 years all the time remaining completely localized. There is no metastasis and except for the slight deformity nothing happens unless there be traumatic injury to bring about ulceration hemorrhage or infection. Such being the case there is no need for prompt surgical intervention for the excision is too apt to be followed by facial palsy to be regarded as a simple matter. Facial palsy is a far more distressing matter than the mere presence of a lump on the cheek.

But there seems to be another matter to which it is very important to direct the attention of the surgeon and one in which mixed tumors seem to differ from all other—recurrence is more frequent when the tumor removed is small. Excision—if it is to be practiced—should be deferred until the tumor is ripe—that is until it attains to a certain size.

By the tabulation of 71 tumors of which the size and behavior were known in such manner as to bring those of the same sizes together the following obtained:

Of 5 tumors	Of 3 tumors	Of 2 tumors	Of 1 tumor	Of 0 tumors	Of 1 tumor	Of 2 tumors	Of 3 tumors	Of 4 tumors	Of 5 tumors
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1

The number of cases concerning which we had these data, 71 tumors with 12 recurrence was not in the eye of some critics sufficient to justify the conclusion but with the increase in the number of cases we now have 126 tumors with 30 recurrences upon which the necessary size data are available. Will the deduction stand or fall? Computation shows the following.

Of 5 tumors	Of 4 tumors	Of 3 tumors	Of 2 tumors	Of 1 tumor	Of 0 tumors	Of 1 tumor	Of 2 tumors	Of 3 tumors	Of 4 tumors	Of 5 tumors
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

It seems therefore that the deduction was justified and the differences emphasized. But as group 3 is very small—19 tumors with only 2 recurrences—it may be well to try other arrangements to escape criticism. If groups 1 and 2 be combined and compared with group 3 we find

Of 5 tumors	Of 4 tumors	Of 3 tumors	Of 2 tumors	Of 1 tumor	Of 0 tumors	Of 1 tumor	Of 2 tumors	Of 3 tumors	Of 4 tumors	Of 5 tumors
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

It was because the small size of group 3 might be the source of error that new combinations were tried. If group 1 be compared with 2 and 3 added together

Of 5 tumors	Of 4 tumors	Of 3 tumors	Of 2 tumors	Of 1 tumor	Of 0 tumors	Of 1 tumor	Of 2 tumors	Of 3 tumors	Of 4 tumors	Of 5 tumors
1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

So it seems that no matter how the grouping is effected the smaller tumors recur about twice as frequently as the large ones probably because the smaller the tumor is the more apt it is to have very small undischarged outlying lobules that are left behind at the operation. When the tumor grows larger these also grow become included in the general tumor mass and are removed with it.

The conclusion seems to be inescapable the tumors should not be operatively removed until they are ripe—that is until they have attained to a size equal to or larger than a lemon.

A newer method of treating tumors is by irradiation by x rays or radium. Applied to all tumors this was of course applied to the mixed tumors with the discovery that they are radio-resistant. When intensively treated they shrink more or less according to the individual case remain inactive for a varying time then resume their usual mode and rate of growth. It did not take long therefore to determine that radiation could not effect cures. But it was imagined that it might be possible to prevent the recurrence of tumors that were to be operated upon by pre-operative or postoperative exposure to the rays.

Among our 301 tumors it is stated in the protocols of 30 that they were at one time or



another exposed to x-rays or to radium or to both. Details of these cases, arranged into what seem to be appropriate groups, are given in Table I.

It may be suggested that the consideration of 30 cases scarcely justifies a positive conclusion regarding the usefulness of x-rays or radium in the treatment of salivary gland tumors, but the list contains all of the cases, whose diagnosis had been confirmed by microscopic examination, that could be found in the many hospitals contributing to this collection. It is quite possible that other cases may have been treated in the outpatient departments of those hospitals but they had no microscopic control and concerning them no records were kept.

Among the cases in Group A—those prophylactically treated by postoperative x-ray exposures—one, Case 242, recurred after 4 years, and had two excisions within 12 months, probably not on account of a recurrence but because the primary tumor was not completely removed, and has had no recurrence in 4 years. This case is, however, paralleled and neutralized by Case 128 in which first an incomplete excision performed February 4, 1931, was followed by another complete operation February 26, 1931. This patient has had no x-ray or radium treatments and has had no recurrence in the 4 years up to 1935 when he was last heard from.

But only one other patient, Case 20, has had a 4 year postoperative period in which the growth might recur, the treatment of mixed tumors by x-rays and radium being relatively very new. The average time at which first recurrences take place is 7 years, a period exceeded only by Case 20. This patient after excision and x-ray treatment has lived for 15 years without recurrence, but this does not differ from Cases 19, 12, 7, 6 and 1 of this series, in which the patients lived respectively 15, 23, 20, 25, and 22 years, after excision, without any exposure to x-rays or radium.

The recurrent cases in Group A, b should not be passed without more specific mention.

In Case 298 the tumor, in spite of exposure to x-rays, promptly recurred and required a second excision within 4 years. Unfortunately

the patient was lost shortly afterward and could never be traced, so that his present condition is unknown.

In Case 139 x-ray treatment was given after the first excision and a second operation was not needed for 5 years. Following that excision the x-rays were applied in 1933, so that only 2 years with freedom from recurrence have passed.

The cases in Group B register bitter disappointments for the most part. In 203, 206, 127 and 85 conditions went from bad to worse and the patients died of the tumors in spite of intensive treatments.

In Case 115, after various excisions and radiations, the patient seemed to be cured, when a small, pale-colored, cystic superficial nodule the size of a pea appeared in the base of the fossa left by the excisions. This was snipped off with scissors and electrodesiccated but a few months later, another similar lesion made its appearance and was later followed by a third. All were similarly treated. The patient was examined recently and there has been nothing more in 6 months.

In Case 46, in spite of intensive treatment, the lump persists. That it has remained small is thought to be to the credit of the treatments, but mixed tumors frequently persist without much change for 10, 20 or even 30 years.

The favorable appearing cases in Group C have already been given their deadly parallels and need no further mention.

To conclude the subject, what can be said except that there is no substantial evidence of radiation being of any benefit whatever?

Some who read the earlier papers shook their heads incredulously and remarked that should a patient come to them with a rapidly growing mixed tumor of the parotid gland, they would take no chances lest it prove to be malignant, but would excise it at once. To such as feel similarly I can only say, first, that rapidity of growth cannot be relied upon to indicate malignant disposition, though the malignant tumors do usually grow more rapidly than others, and second, that if the tumor is really malignant, it does no good to operate upon it. These statements seem justified from a study of the cases in Table II.

TABLE I.—AN ANALYSIS OF 30 CASES TREATED BY X RAYS AND RADIUM

1. See ten cases from which no conclusion can be arrived at. There is a first case in favor of the fact that the effects of the operation and the topographical position of the tumor are too important to be left to chance.

Pre-operative	Sex	Age	Color	Site	Time
Case	Sex	Age	Color	Site	Time
Case 6	M	44	W	3 yrs	Ex used 9 and 9 1/2
Case 3	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 1	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 2	M	3	W	3 yrs	Ex used 9 and 9 1/2
Case 27	M	3	W	3 yrs	Ex used 9 and 9 1/2
Case 28	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 29	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 30	M	3	W	3 yrs	Ex used 9 and 9 1/2
Case 31	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 32	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 33	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 34	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 35	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 36	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 37	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 38	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 39	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 40	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 41	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 42	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 43	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 44	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 45	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 46	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 47	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 48	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 49	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 50	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 51	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 52	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 53	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 54	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 55	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 56	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 57	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 58	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 59	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 60	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 61	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 62	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 63	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 64	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 65	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 66	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 67	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 68	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 69	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 70	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 71	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 72	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 73	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 74	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 75	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 76	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 77	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 78	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 79	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 80	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 81	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 82	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 83	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 84	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 85	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 86	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 87	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 88	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 89	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 90	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 91	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 92	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 93	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 94	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 95	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 96	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 97	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 98	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 99	F	3	W	3 yrs	Ex used 9 and 9 1/2
Case 100	F	3	W	3 yrs	Ex used 9 and 9 1/2

TABLE II—PAROTID TUMORS OF RAPID DEVELOPMENT AN ANALYSIS OF THE RELATION OF GROWTH RATE TO MALIGNANT BEHAVIOR

Case	Sex	Age	Side	Pre operative duration	Size of tumor	Microscopy	Outcome	
A	3	F	33	L	2 mos	Orange	Mixed tumor	No recurrence Died of pneumonia 5 years after operation
	16	M	22		6 mos		Mixed tumor	Recurred in 6 years and again in 2 years Lost
	18	M	31	R	2-3 mos	Plum	Mixed tumor	No recurrence Patient died of appendicitis 10 years later
	28	M			16 mos		Mixed tumor	No recurrence up to 16th year
	44	M	28	R	15 mos		Mixed tumor	No recurrence in 4 years Lost
	67	F	28	L	6 mos	Lemon	Mixed tumor	No recurrence in 16 years
	72	M	40		1 yr		Mixed tumor	No recurrence in 22 years
	74	F	30	R	1 yr	Lemon	Mixed tumor	No recurrence in 15 years Lost
	75	F	19	L	14 mos	Walnut	Mixed tumor	No recurrence in 11 years
	97	M	28		1 mo	Walnut	Mixed tumor	No recurrence in 8 years
	105	M	34		18 mos		Mixed tumor	No recurrence in 19 years
	218	M	42		4 mos	Olive	Mixed tumor	No recurrence in 15 years
	242	F	28		6 mos	Hazel nut	Mixed tumor	No recurrence in 4 years
	306	F	49	L	2 mos	Walnut	Mixed tumor	No recurrence in 3 years
	314	M	28		1 yr	Grape	Mixed tumor	No recurrence in 2 years
B	77	M	51	R	4 mos	Orange	Suggestive of carcinoma	Five excisions were made during 6 months, then the patient died of the tumor
	78	M	62	R	6 mos		Suggestive of carcinoma	Died some weeks after the excision of a recurrent tumor
	79	M	62	L	15 mos		Suggestive of carcinoma	Died within a year, of the tumor
	80	F	28	R	12 mos	Lemon	Suggestive of carcinoma	Died of "general carcinomatosis " Date unknown
	81	M	75	R	1 mo	Lemon	Suggestive of carcinoma	Never improved after operation and died of the tumor
	82	M	52	L	12 mos	Very large	Suggestive of carcinoma	Had recurrences and operations subsequently Lost
	87	M	60		7-8 mos	Lemon	Suggestive of carcinoma	No information except that the patient is dead
	185	M	59		7 mos	Egg	Suggestive of carcinoma	Recurred underwent a second operation then was lost

It was from such data as this that I reached the conclusion, already published, that if the pre-operative duration of the tumor is short (expressed in months instead of years) and its microscopic structure suggestive of carcinoma, its prognosis is bad. It may be safe to add that the age of the patient may also be of prognostic value, for in group A the average age is 31 years, while in Group B it is 56 years. One must be cautious, however, with respect to the value of age data. Though there is no patient more than 50 years old in Group A, there is one patient, Case 80, in Group B, who was only 28 years old. Just what is meant by the expression "general carcinomatosis" in his case is doubtful, for the tumor was a typical mixed

tumor and his death certificate says that death was from "mixed tumor of the parotid." It may have been one of the rare metastatic mixed tumors like that reported by Kornblith. Unfortunately, no necropsy was held so that we can never be sure, but before death an x-ray examination revealed what were supposed to be nodules in the lungs. It has been argued that the malignancy of the future course of a tumor is indicated by the promptness with which it recurs after excision. There is some truth in the assertion, but it is by no means a dependable index. I have data upon 24 cases bearing upon this subject. Unfortunately it lacks uniformity in one particular: in 16 cases the protocols give the period elapsing between the first operative removal



when it was again operated upon, after which 2 years have passed without recurrence (1935) Case 232 is a sublingual tumor of 3 years' duration that recurred in 3 months and was subjected to a second excision in 9 months (1935)

In order to see whether the age of the patient at the time of the first operative treatment had any bearing upon the prognosis, the following statistics were gathered from cases accompanied by the necessary age data

1.0 cases in which no recurrence had been reported the average age was 43 years  
 55 cases in which 1 recurrence has been reported the average age was 45 years  
 30 cases in which 2 recurrences have been reported the average age was 49 years  
 17 cases in which more than 2 recurrences have been reported the average age was 41 years

From these figures it does not seem as though the age at which the patient comes to operation is of much prognostic importance

Perhaps more could be learned by noting the age of the patient when the tumor first made itself known. Unfortunately this computation is subject to error because many patients having had one or two recurrences have died, or been "lost." In the former case, of course, no one could know what might have happened, and in the latter we do not know what has happened. Furthermore, patients with whose tumors we became acquainted 10 years ago, and some of whom were operated upon long before that, have had a better opportunity to manifest their tendency to recurrence than those operated upon only a few years ago

81 cases of tumors in which no recurrence has been reported average age 35 years  
 5 cases of tumors reported to have recurred but once average age 35 years  
 20 cases of tumors reported to have recurred twice average age 33 years  
 7 cases of tumors reported to have recurred more than twice but were not fatal average age 22 years  
 3 cases of tumors reported to have recurred more than twice and have proved fatal, average age 42 years

If the last two groups are blended, 12 cases of repeatedly recurrent and fatal tumors have an average age of 32 years. This may indicate that the 5 cases whose average age at the time the tumor was first discovered was 42 years had tumors differing in kind from the 7 cases whose average age was 22 years, the former being carcinomas and the latter mixed tumors. The difficulty of differential diag-

nosis in these cases has already been discussed

It seems very difficult to arrive at any satisfactory conclusions with respect to the mixed tumors. Their nature and origin are uncertain, their structure various, correlation between their structure and clinical behavior contradictory, the efficiency of any of the methods of combatting them doubtful.

Considering that the average interval between the first operation and the first recurrence is 7 years, but that in Case 90 recurrence occurred after 12 years, in Case 127 after 12 to 14 years, in Case 188 after 15 years, in Case 91 after 15 to 18 years, in Case 47 after 30 years, in Case 50 after 30 years, in Case 250 after 32 years and in Case 318 after 47 years, how is it possible to say that any case has certainly been benefited or any case cured?

The statement made in my third paper, conclusion 10, "when growth is so rapid as to bring the patient to the operation within a year and the excised tissue resembles carcinoma, the prognosis is bad," holds, but needs further comment, for with it go the correlaries that "small tumors should not be removed" and that "operation in such cases does no good."

Might the taking of a biopsy be of assistance? In cases in which the diagnosis of mixed tumor is uncertain, and the lesion might be a lymph node with secondary carcinoma, or tuberculosis or Hodgkin's disease, or some other tumor such as schwannoma or capillary angioma, a biopsy may be useful in revealing the true nature of the suspected lesion. But if its purpose is to determine the prognostic probabilities in the case of mixed tumor, it may be put down as useless because of the lack of correlation between the histopathology of the tumor and its clinical behavior, as has been so carefully pointed out.

It is also difficult to escape the conviction that the biopsy of a mixed tumor may do harm, for it is known that the cells of the tumor grow quite readily *in vitro*, and among our cases those in which "partial excision was performed," or "the capsule broke" or "the tumor was picked out in pieces," there was immediate recurrence. To take biopsy mate-



# CLINICAL SURGERY

FROM THE NEW YORK HOSPITAL AND CORNELL UNIVERSITY MEDICAL COLLEGE

## SURGICAL TREATMENT OF TUMORS OF THE MEDIASTINUM

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AS THE experience of surgeons with tumors of the mediastinum has increased, and more and more successful results have appeared in the literature, it has become evident that in all such cases the advisability of surgery should be considered. To be sure, in certain groups, such as the lymphosarcoma or in Hodgkin's disease, surgery has little or nothing to offer except as a diagnostic aid, but in most of the others the operative results have become increasingly more satisfactory, and in many definite benefit, varying from worth while relief of symptoms to spectacular cure, has been obtained.

Before surgery is undertaken, however,—granting the condition of the patient is such as to permit operation—the case should be carefully studied from several points of view, in order to determine as accurately as possible the size, location, extent, and type of tumor present. To this end, all available resources of the internist, roentgenologist, bronchoscopist, and surgeon may be called upon, for while diagnosis of a mediastinal mass may be comparatively easy from symptoms and physical signs, further information is quite necessary before surgery is undertaken.

Like intracranial tumors, those of the mediastinum give rise to what may be called general symptoms, more or less common to all types, and to others tending to indicate the site and to a certain extent the type of tumor present. Among the former are included pain, cough, dyspnea, and cyanosis, while the special symptoms include those of pressure on certain vessels, nerves, or portions of the bronchial tree or esophagus. Thus, the history of Horner's syndrome, in a patient with a demonstrable intrathoracic mass, strongly suggests the presence of a tumor arising from the paravertebral chain, usually a ganglioneuroma or neurofibroma, while the expectoration of hair points to a dermoid cyst, which is commonly found in the anterior or superior portion of the mediastinum.

The physical examination may show decreased expansion or bulging of a portion of the chest, accompanied by dullness, or other signs either directly attributable to the tumor or produced by pressure on the mediastinal structures. The laboratory studies, aside from roentgen-ray examination, are sometimes informative, as when characteristic tumor material is found in the sputum or in fluid obtained by thoracentesis. The leucocyte count also may be of aid in distinguishing between a tumor and an inflammatory process, although its value is often vitiated by the presence of pulmonary complications.

The roentgenogram, however, is perhaps the most important single aid in diagnosis, in deciding whether or not surgery is advisable, and, once operation is decided upon, in indicating the best approach to the lesion. The most important characteristics of the tumor shadow from the standpoint of roentgenological diagnosis are its location, the character of its edge—whether smooth and regular, or irregular and infiltrating—the density of the mass, and whether this is uniform or greater in some portions than in others. These findings are sometimes better elicited after diagnostic pneumothorax, as the injection of even 250 or 300 cubic centimetres of air may be of material aid in indicating the precise location of the tumor, and, by bringing about a sharper outline, in showing more accurately its demarcation from the surrounding tissues. Finally, in some cases information regarding the nature of the tumor can be obtained by careful studies of its response to controlled doses of roentgen-ray.

Bronchoscopy is often indicated when there are signs of pressure on the bronchi, and particularly when there is evidence of atelectasis, provided, of course, that a diagnosis of aneurism can be excluded. Rarely, what has appeared from other examinations to be a mediastinal tumor may

prove on bronchoscopy to be the result of the secondary effects of an intrabronchial neoplasm which may be best treated endobronchially.

In tumors lying close to the chest wall aspiration with a large bore needle may yield material which on histological study will establish the diagnosis.

However useful as the above methods of examination may be and clear cut as the signs elicited by them in uncomplicated cases often are the presence of pulmonary or pleural complications or secondary effects of the tumor may so bedevil the picture as to make accurate diagnosis before operation extremely difficult or impossible. In some such cases this can be arrived at only by exploratory operation with biopsy.

Occasionally the removal of a lymph node from the supraclavicular region may be of aid in establishing the diagnosis but when these glands are involved surgical attack on the intrathoracic mass is of course contra indicated.

#### DERMOID CYSTS AND TERATOMAS OF THE MEDIASTINUM

It is customary to include under one or the other of these terms cysts or tumors of varying grades of complexity from simple so called epidermoid cysts to the histologically more involved teratomas. Reports of more than 150 such cases may be found in the literature and undoubtedly many more have been observed.

These tumors are congenital and probably arise from rests or misplacements of branchiogenic cells drawn into the thorax by the descent of the diaphragm and heart. They are found most frequently in the superior and anterior mediastinum in front of the great vessels and often in contact with the pericardium although they may assume other positions. In a number of the reported cases the tumor apparently arose from the thymus.

Of slow growth dermoid cysts and teratomas usually remain quiescent for a number of years symptoms often dating from an injury or from the onset of other intrathoracic disease. Dyspnea, cough and poorly localized pain are the common symptoms at first while if the tumor be of relatively large size those of mediastinal compression may be present. If the tumor is infected all the symptoms may be aggravated. Rupture of a cyst into a bronchus may be heralded by the expectoration of grumous material sometimes containing hair.

Malignant changes may take place in the tumor of either sarcomatous or carcinomatous nature but this is a distinctly rare occurrence.

even if such an origin be assumed for the occasional carcinoma of the mediastinum the origin of which cannot be traced.

**Diagnosis.** Since many of these tumors remain quiescent for a long period of time they may be found only incidentally in the course of routine examination as for life insurance or at post mortem. The expectoration of hair is of course pathognomonic and occasionally constitutes the initial symptom. The roentgen ray examination however is of the greatest value. A spherical non pulsating shadow in the anterior or superior mediastinum or as more commonly seen projecting out into the lung field from this region when taken with the clinical features often seen makes the diagnosis almost certain. If bone teeth be present in the cyst they may be visible in the roentgen ray picture.

**Treatment.** While the advisability of surgery in cases without symptoms may seem debatable these tumors if untreated eventually give rise to serious symptoms so frequently and complications such as rupture into a bronchus with infection of the cyst so often occur and add to the hazard and difficulty of surgery that it seems wise to advise extirpation of the cyst in all with the possible exception of asymptomatic cases which can be examined at frequent intervals. Even in such instances however it is impossible to predict when rupture into a bronchus may occur.

The ideal procedure is complete extirpation of the cyst as this has given the highest percentage of cures and has been associated with the lowest mortality.

The results in 151 cases including 6 of our own have been as follows:

Twelve were found at autopsy the details are unknown in 8 and 46 died untreated. The 85 remaining were subjected to surgery.

Of the patients subjected to surgery 34 were treated by incision and drainage with or without marsupialization of the cyst. Of these 11 (32 per cent) died 1 was unimproved 8 recovered with fistulas in 2 the result was unknown 5 were temporarily cured and only 5 (14 per cent) permanently cured.

Thirteen were treated by incomplete excision of the tumor of these 2 (15 per cent) died 4 recovered with incisions and 5 temporarily recovered. In 1 case the result is unknown.

In 38 patients the tumor was completely removed with 4 deaths (10 per cent) including 1 patient who died from cerebral embolism 1 week after operation. All the remaining ones (39 per cent) were cured.



*Choice of operation* The surgical attack on these tumors depends somewhat on their position and size and the presence or absence of infection, all cysts that have ruptured into a bronchus being considered as infected. In the case of the relatively small cysts located in the anterior mediastinum, an anterior approach through a T incision, with the cross-bar along the side of the sternum, resecting the third or fourth costal cartilage and a portion of the corresponding rib with division of the cartilages immediately above and below, will often give adequate exposure, and if the cyst wall be not too adherent to the surrounding structures, may permit its complete removal extrapleurally. For the larger cysts, transpleural approach through wide intercostal incision, with rib resection as required for exposure, may be used, but in the case of infected cysts adds the hazard of infection of the pleura. Trap-door incisions and longitudinal sternotomy have also been used. We prefer the simplest type of approach compatible with good exposure, and one which can be easily closed, leaving the thoracic cage as little deformed as possible.

Cysts located high in the superior mediastinum or tending to project from the superior thoracic aperture may be approached through a goiter incision combined with high median sternotomy or resection of a portion of the manubrium. The occasional dermoid of the posterior mediastinum may be attacked from behind, often extrapleurally, after resection of the posterior ends of several ribs, with or without removal of the corresponding transverse processes.

In the case of infected tumors, it is best to perform the operation in stages, first isolating the cyst from the surrounding structures so far as possible and paying particular attention to protecting the pleural cavities and pericardium from infection. This last is most important, as these cysts are often intimately attached to the pericardium, postoperative infection of which is nearly always fatal.

The more solid teratomas are often difficult to extirpate in one stage and may require numerous operations at which they are removed piecemeal. In the process they usually become infected, and portions may slough away. Subsequent irrigation or packing with Dakin's solution sterilizes the remaining cavity.

**CASE 1** E G S Dermoid cyst (Fig 1) The patient, a 56 year old woman, first admitted to the New York Hospital on November 15, 1920, at which time an adenoma of the thyroid was removed. Recovery was uneventful and pathological report indicated that the adenoma removed was in no way unusual.

On January 18, 1933, she was admitted complaining of

extreme dyspnea and non-productive cough, but no pain. Examination showed marked dyspnea on slight exertion, the chest dull to percussion on the right, with bronchial breath sounds and a few rales. Roentgenogram showed displacement of the trachea to the left, and a large, well outlined tumor in the right upper lung field.

On January 27, 1933, under local anesthesia, a thoracoplasty and exploration of the chest was performed, and the tumor was found to be about the size of a grapefruit. During manipulation, its capsule was ruptured with escape of a large quantity of chocolate-colored fluid. On account of the patient's condition, it was considered unwise to proceed with removal, and the wound was packed with saline after the tumor was completely walled off from the pleural cavity. After a week the packs were removed and drainage established, the marsupialized tumor mass sloughed out slowly, and 2 months after operation only a very small piece of it remained, which soon came away. From this time on, the wound healed gradually and the patient gained rapidly. Repeated roentgenograms showed only scarring and fibrosis in the tumor region. Nine months after operation no signs of the tumor remained, and the patient was entirely free of symptoms.

**CASE 2** E B Dermoid cyst of mediastinum (Figs 2, 3, and 4) This patient was an 11 year old colored girl, who was admitted to the hospital for further study of a chest tumor which had been discovered during the course of a routine roentgen ray examination. She was without complaints of any nature.

Physical examination on admission was negative except for a circular area of flatness in the anterior chest, extending from the sternum to about the midclavicular line. The heart was displaced slightly to the left. Roentgen ray examination revealed a shadow of smooth outline and blending with that of the right side of the heart, extending out into the right lung field. Oblique and lateral films showed this to be distinct from the heart shadow, however, and it was thought to arise from the chest wall.

One week after admission the tumor was removed under intratracheal anesthesia, through an incision along the right border of the sternum, with the resection of a portion of one rib. The tumor lay in the anterior mediastinum, was attached to the pleura and to the pericardium and seemed to have its origin in a persistent thymus. It contained about 100 cubic centimeters of thick brownish fluid, and microscopic examination of the cyst wall showed it to be a relatively simple teratoma.

Convalescence was uneventful save for a pleural effusion, which disappeared within 3 weeks after operation. Three months later the patient was in good health and able to return to school.

#### CYSTS OF ENDODERMAL AND MESODERMAL ORIGIN

About 15 cases of cystic tumors of the mediastinum have been reported which were not true dermoids, but in the walls of which tissues of endodermal or mesodermal origin were to be found. These would appear to have arisen from cells displaced during the development of the upper gastro-intestinal tract, lungs and bronchi, and have thus come to contain such tissues as ciliated epithelium and mucous glands, cartilage, or gastric mucosa. They are usually thin-walled, and contain clear, milky or opalescent, and rather viscid fluid. Differentiation from the dermoid

cysts has not been possible before operation or aspiration and indeed the distinction rests on histological rather than on clinical grounds.

They may be treated by extirpation if this is possible or by marsupialization followed by irrigation with Dakin's solution.

#### CYSTIC LAMPRACIDOMAS

These may be found in the mediastinum usually near the hilum or in connection with the pericardium. Some have attained considerable size. Excision was attempted in Michaelis' case but this proved to be impossible and the patient died.

#### ECHINOCOCCUS CYSTS

Echinococcus cysts of the mediastinum are distinctly rare even as compared with those of the lungs and pleura. The diagnosis rests upon the presence of echinococcus disease elsewhere in the body or the finding of characteristic scolices hooklets or part of the cyst membrane in the sputum. Eosinophilia if present is suggestive but is more often equivocal in intrathoracic hydatids than in those of the liver. The Cassoni skin test is also of aid if positive but fails to appear in about 10 per cent of the cases.

Aspiration of intrathoracic echinococcus cysts is a dangerous procedure as rupture of the cyst with flooding of the bronchi or grave even fatal toxemia have followed in a number of instances.

A survey of the reported cases indicates that complete extirpation of the intact cyst or evacuation followed by removal of the cyst wall are the procedures of choice.

#### CONNECTIVE TISSUE TUMORS

Connective tissue tumors of the mediastinum include the pure fibromas as well as others in which fibrous tissue is only one element in a more or less complex type of tumor containing other tissues of mesodermal origin as for example the fibrosarcomas or of ectodermal derivation such as the neurofibromas or gangliogliomas. Chondromas or chondromyxomas are even more frequently encountered while lipomas and the rarer xanthomas also occur in this region.

*a. Fibroma.* Pure fibromas are rare in the mediastinum most of the reported tumors containing other connective tissue elements as well. They are often adherent to the mediastinal structures or to the pleura or diaphragm are well encapsulated and like fibromas elsewhere are of variable consistency.

The symptoms and signs are those common to other tumors of the region and the growth may be present for a considerable time without giving

rise to symptoms. Depending on their location and size they may cause pain, cough and dyspnea and other symptoms and signs of pressure on the mediastinal structures. The roentgenogram shows a clearly defined and circumscribed shadow blending with that of the mediastinum.

Positive diagnosis has only been possible at operation or autopsy.

Surgery is indicated if possible as in a group of 18 cases in the literature 13 who were not operated upon died while all of the 5 subjected to surgery recovered.

*b. Neurofibroma.* Arising from the sheaths of the thoracic nerves or the paravertebral sympathetic chain these tumors are usually found in the posterior mediastinum. The clinical features are similar to those of ordinary fibroma but pain tending to radiate along the course of the intercostal nerves is an early and prominent symptom. Composed largely of fibrous tissue they may also contain nerve fibers as well as some of the more primitive connective tissue elements such as myxomatous tissue. When such tumors arise in the intervertebral foramina they may extend into the spinal canal as well as into the thorax giving rise to the so called hour glass tumors and often causing symptoms of compression of the spinal cord. Laminectomy as well as thoracotomy may be required for their removal.

Such hour glass shape may also be assumed by malignant tumors arising in the posterior mediastinum. A case of this type which came under our observation and was operated upon proved to be a neuroblastoma apparently connected with the paravertebral ganglionic chain.

In the case of neurofibromas of the intercostal nerves some erosion of the ribs immediately above and below the site of origin of the tumor may be evident in the roentgenogram which otherwise simulates closely that of ordinary fibroma.

The treatment is surgical and the prognosis good provided operation is undertaken before the tumor has attained too great size or has undergone malignant changes. Harrington has reported 14 cases with 2 operative deaths and 1 death 2½ years after operation from recurrence of a malignant tumor.

*Case 3. H. C. Neuroblastoma.* The patient was a 9 year old Jewish boy who for 4 months before admission had increased glycosuria, polydipsia, the thoracic region of the spine for 4 years before admission the left leg became paralyzed and the cerebellar gait and head pain both lower extremities.

Physical examination on admission was negative except for slight thoracolumbar kyphosis and chest tenderness which were percussive dull from the spine to the tip of the scapula and extending from the 7th to the



Fig 1 Dermoid cyst of the mediastinum projecting into right apex

seventh vertebra, breath sounds suppressed under this region. Roentgenogram showed a dense tumor mass extending chiefly to the left of the bodies of the sixth to the ninth thoracic vertebrae. Slight extension of the tumor mass on the right also. The mass was well defined and



Fig 2 Mediastinal dermoid cyst in a child 11 years of age. Antero posterior view

made up of several layers, there was a slight scoliosis to the right in this region and some erosion of the left pedicle of the eighth segment.

By the fourth day after admission the signs of cord compression at about the level of the sixth dorsal vertebra had become clear. Despite a rise in temperature to 40 degrees, for which no cause could be found, a laminectomy and partial resection of the cord tumor was performed on the following day—partial because collapse of the patient



Fig 3 Mediastinal dermoid cyst. Oblique view in patient depicted in Figure 2



Fig 4 Postoperative roentgenogram of patient depicted in Figures 2 and 3



Fig 5 Echocardiogram of the mediastinum



Fig 6 Lateral chest X-ray showing a large mass in the mediastinum

med. med. d. t. thd. l. n. r. Th. tumor. wa. f. u. d. t. l. b. t. w. e. n. t. h. t. h. a. d. n. t. h. d. s. a. l. g. m. t. d. t. c. i. t. i. h. c. d. a. t. i. h. l. e. f. t. f. t. h. g. h. t. s. e. g. m. t. Th. p. o. t. p. u. c. u. r. s. w. a. p. g. r. l. y. d. h. l. De. p. t. e. t. a. f. s. n. d. t. h. p. p. o. t. m. a. e. s. t. h. p. t. t. e. p. e. d. n. t. h. t. h. d. y. a. l. l. p. r. a. t. Aut. p. y. h. w. e. d. t. h. e. m. t. b. e. n. o. b. l. s. t. m. w. i. t. h. t. n. t. h. p. o. s. t. o. m. d. s. t. n. u. m. d. t. i. t. h. l. y. s. g. l. u. r. a. f. t. h. l. f. t. l. u. n. g. C. s. 4. H. O. Myx. o. b. i. r. m. (F. g. s. 7. d. 8). Th. s. p. t. i. a. 39. r. l. d. w. m. a. n. w. h. e. t. r. d. t. h. e. h. p. i. l. f. b. r. u. r. y. 0. 34. m. p. l. a. s. g. f. l. e. q. t. d. d. n. t. t. a. k. s. f. b. n. h. u. t. t. h. u. n. p. r. o. d. u. t. c. g. b. a. p. e. r. i. o. d. f. i. s. a. d. p. d. e. t. t. k. s. f. t. u. g. o. o. t. s. o. c. i. a. t. e. d. i. t. h. m. i. n. g. r. i. s. s. f. e. c. c. s. d. n. g. t. h. p. s. t. y. r. A. t. y. p. I. I. e. y. n. d. m. t. h. r. i. g. h. t. h. a. d. d. l. i. d. d. i. n. g. t. h. p. t. s. y. a. r. s. I. t. l. u. t. r. y. n. t. r. m. k. a. b. l. e. p. t. f. s. e. e. m. c. h. a. g. o. i. t. h. h. t. m. d. g. f. f. b. d. f. t. h. u. t. r. u. w. s. m. d. d. r. a. d. i. u. m. t. h. p. y. g. n. d. g. t. f. a. l. m. p. u. s. e. Ph. y. c. a. l. m. t. r. a. l. e. d. g. f. m. p. s. u. o. n. i. n. t. h. r. f. t. h. g. h. t. p. p. r. l. m. r. y. f. b. d. o. e. t. g. o. i. m. f. t. h. e. b. t. h. o. d. l. g. s. u. l. d. t. m. r. o. c. p. y. n. g. b. t. i. h. -q. r. t. r. s. f. t. h. g. h. t. p. p. e. b. e. s. t. l. i. g. h. t. l. y. d. p. l. c. g. t. h. t. c. h. O. M. 3. 3. 0. 3. 4. t. i. e. m. a. s. m. e. d. a. d. f. d. t. l. m. y. l. b. m. a. t. h. d. t. i. m. l. g. a. n. c. y. C. n. l. e. s. c. " a. t. t. a. l. a. n. d. t. h. p. a. t. t. s. d. s. c. h. g. d. " t. h. r. t. y. f. i. t. h. p. t. p. t. d. y. w. t. h. t. w. d. w. l. l. h. l. e. d. b. t. c. h. e. z. i. t. h. I. I. y. n. l. m. T. m. t. l. a. f. t. p. t. t. h. p. t. t. w. t. t. h. t. h. f. t. m. i. l. l. p. t. t. h. t. h. i. l. l. h. a. d. l. i. g. h. t. t. d. c. y. t. i. l. h. i. d. l. i. g. h. t. d. a. z. z.

c. Ganglioneuroma. Although in most of the reported cases of ganglioneuroma the tumor has

been located outside the thorax—in the neck or abdomen—a number have been found in the posterior mediastinum—springing from the thoracic sympathetic chain. They appear grossly as firm lobulated tumors of varying size up to 10 centimeters in diameter. Microscopically they are composed of a reticular network containing numerous multipolar ganglion cells.

The symptoms are those of intrathoracic fibromas but when Horner's syndrome appears early or is the initial symptom a ganglioneuroma should always be considered.

These tumors can usually be removed surgically and this is the treatment of choice as they are quite insensitive to radiation.

d. Lipoma. Twenty seven cases of lipoma involving the mediastinum have appeared in the literature and may conveniently be divided into three groups. First a group comprising about two-thirds of the total number in which the tumor is entirely intrathoracic; another group in which the tumor is roughly dumb bell shaped the intrathoracic and extrathoracic portions being connected by a narrow isthmus which traverses an aperture in the thoracic wall and a third group in which a mediastinal tumor extends upward into the neck.

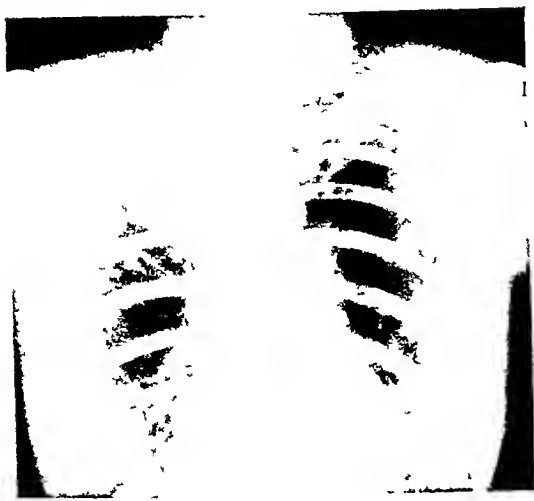


Fig 7 Myxoneurofibroma arising from the paravertebral sympathetic chain

Because of their slow growth and soft consistency, these tumors are often slow in producing pressure symptoms, and may grow to considerable size, in one case (Leopold's) weighing 17½ pounds

The diagnosis of intrathoracic lipoma has seldom been made before operation or necropsy, but the presence in the roentgenogram of an intrathoracic shadow of clearly demarcated outline and with its central portion denser than the periphery should make one consider lipoma as a possible diagnosis. When such a shadow is present within the thorax beneath an external tumor in the chest wall or neck which presents the physical findings of a lipoma, the diagnosis is suggested.

An attempt at extirpation of the smaller and moderately large tumors should certainly be made, and even though they be of considerable size, surgery should be considered, for autopsy in the cases of intrathoracic lipomas has shown that they are well encapsulated and can be enucleated with surprising ease.

The outcome of the cases in the literature is as follows: of the 12 patients in whom the tumor was only partly intrathoracic, an external tumor also being present, 11 were operated upon and 1 died without treatment. Seven of the 11 were cured, while 4 died. The tumor was entirely intrathoracic in 17, and 14 of these died untreated while the 3 in which the tumor was removed were cured.

CASE 5 F. C. Intrathoracic lipoma (Figs 9 and 10)  
The patient was a 23 year old girl who entered the hos-



Fig 8 Lateral roentgenogram of patient depicted in Figure 7

pital on December 5, 1932, with a history of pains in the chest, shortness of breath, and choking sensations of 10 months' duration, beginning with a sharp attack of pain and pressure symptoms in the left chest, and intensified at the beginning of each menstrual period. Repeated aspirations which were performed at hospitals where she went for observation failed to reveal the presence of fluid in the chest.

Physical examination showed the patient to be cyanotic and somewhat dyspneic, the trachea was shifted to the right. Expansion was limited in the lower anterior chest and absent in the left chest posteriorly. There was a marked bulge in the upper anterior thoracic wall. Left chest showed dullness on percussion, breath sounds absent in the left axilla and left back, and numerous wet rales at the right base, voice sounds were diminished over the left chest. Heart sounds were of good quality but rapid. Roentgenogram showed the trachea and heart displaced to the right, and the entire left lung held obscured homogeneously.

After putting the patient in the best possible condition, a thoracoplasty was done under local anesthesia, yellowish, mucoid material was first aspirated from the tumor, and then a section of the tumor tissue was taken for biopsy, this being diagnosed upon microscopic examination as lipoma.

On January 5, 1933, an attempt was made to remove the tumor surgically, but while novocain was being injected into the intercostal space inferior to the sixth rib, the patient moaned and underwent tonic and clonic convulsions and in spite of all attempts at resuscitation, died within a few minutes.

Autopsy showed the tumor measuring 25 centimeters both longitudinally and transversely at its widest diameter, occupying most of the chest cavity and apparently originating in the anterior mediastinum. Microscopic examination of the tissue showed the tumor to be a lipoma.



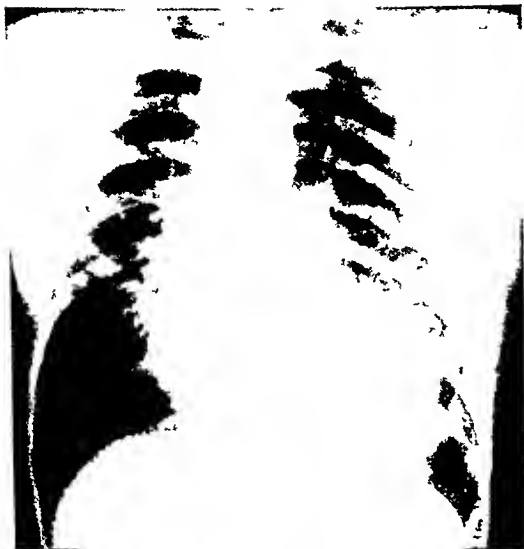


Fig. 11 Chondroma of the mediastinum arising from the costal cartilages



Fig. 12 Chondroma of the mediastinum Lateral roentgenogram of patient depicted in Figure 11

material. Roentgenogram showed an extensive tumor formation along the interior chest wall on the right, near the midline, in the region of the seventh, eighth and ninth costal cartilages with apparently no involvement of bony portions of the ribs or of the sternum or xiphoid process.

On March 22, 1935, thoricotomy was done and the tumor was found to be densely adherent to the pleura and, at its upper margin, to the lung. A large section of the anterior chest wall, including the tumor, the scar of the previous removal and portions of the fifth and sixth ribs, was removed. Microscopic examination revealed the tumor to be an enchondroma, invading the bone upon which it abutted, with no evidence of malignancy.

Convalescence was complicated by hemothorax, empyema and infection of the wound, but after thoracocentesis on two occasions followed by drainage and irrigation of the empyema cavity, the patient began to show signs of progress and was at length discharged (on July 7, 1935) in good condition, with a very small granulating wound.

#### XANTHOMA

The literature contains reports of 5 cases of mediastinal tumor diagnosed, on pathological examination, as xanthoma. Xanthomas are benign tumors, and amenable to operative removal. In one of the reported cases pleural effusion was present.

CASE 7. K. Xanthoma of the mediastinum (Figs 13, 14, and 15). The patient, a physician aged 29 years, had for 14 years cramp like pain in the right lower quadrant, the pain persisted in spite of appendectomy 8 years previous to admission, and examination of the genito urinary and gastro-intestinal tracts was negative. The patient began to have severe pain in his back which was called lumbago. Roentgenogram of the chest 1 year before admission showed a mass behind and to the right of his

heart shadow. Exploration with a needle was negative. Radium treatment was given, without benefit. Physical examination was negative except for the tumor shown in the roentgenogram.

At operation, October 15, 1919, 6 inches of the ninth rib were resected and the tumor exposed without opening the pleural cavity. It was larger than a hen's egg, lay against the bodies of the vertebrae, and seemed attached to the tenth rib. The pleura was readily separated from it, and the tumor removed together with portions of the tenth and eleventh ribs.

Convalescence was uneventful with the exception that the extrapleural space filled with fluid, which, however, subsequently disappeared. The wound healed *per primam*. The patient was perfectly well and free from pain 4 years after operation.

#### PRIMARY TUMORS OF THE MEDIASTINAL LYMPH NODES

Aside from their frequent involvement in metastases of malignant tumors originating outside of the mediastinum proper, and in the leucemias, the mediastinal lymph nodes may be the site of several varieties of primary neoplasms. The morphology of these conditions varies considerably with the disease and the type of cell affected. Those most important from the surgical standpoint are lymphosarcoma, Hodgkin's disease, and endothelioma of the lymph nodes. As



Fig. 3. Anterior and posterior views of the thorax.

indicated in one of the opening paragraphs from the standpoint of cure surgery has little or nothing to offer in these conditions but a knowledge of their diagnostic features is of great importance from the standpoint of differential diagnosis and while we can hardly speak of cures great relief of symptoms in association with considerable decrease in the size of the nodes may follow the use of adequate roentgen ray treatment.

*a Lymphosarcoma* This is the commonest type of neoplasm encountered in the mediastinum



Fig. 4. Lymph node removed from the mediastinum. (Gross specimen.)



Fig. 5. Lymph node removed from the mediastinum. (Gross specimen.)

constituting as high as 50 per cent of some series. Occurring most frequently between the ages of 30 and 50 and predominantly (2 to 1) in males, these tumors give rise to pain, cough, dyspnea and other signs of mediastinal compression and because the condition may arise in the thorax and extend to the nodes of the neck or vice versa enlargement of the cervical nodes is often evident. Cough is usually dry or with frothy expectoration but hemoptysis is not uncommon. Low grade fever below 100 degrees F is the rule even in the absence of complications.

The physical signs depend largely upon the size and location of the enlarged nodes and they are usually those of compression of various mediastinal structures.

Pleural effusion occurs in about 50 per cent of the cases and in some of these characteristic cells may be found in the sediment of centrifuged fluid which has been obtained by thoracentesis. If an enlarged node can be removed for histological examination the diagnosis is established. Benign lesions are much less common and are of slower growth.

The roentgenogram shows an irregular widening of the mediastinal shadow, particularly in its





Fig 16 Lymphosarcoma of mediastinum

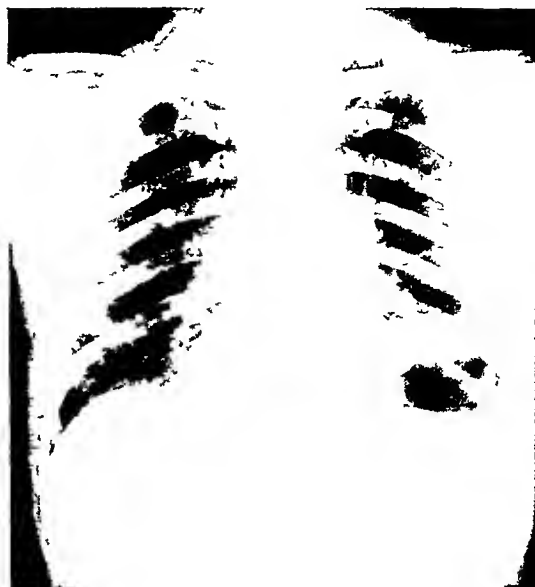


Fig 17 Lymphosarcoma of mediastinum Roentgenogram of patient depicted in Figure 16, after intensive roentgen-ray therapy. Note the paralysis of the left hemidiaphragm which was present at intervals during this patient's course



Fig 18 Hodgkin's disease involving the mediastinal nodes



Fig 19 Hodgkin's disease of the mediastinal nodes after roentgen ray treatment



Fig. 1. Malignant tumor of the superior mediastinum (thymoma).

choice and great relief of symptoms may follow temporarily but recrudescence is the rule and the effectiveness of radiation diminishes with successive treatments.

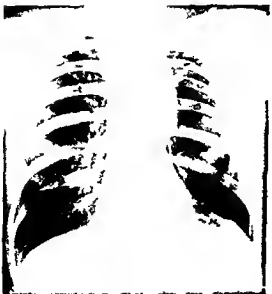


Fig. 2. Carcinoma of the superior mediastinum of undetermined origin.



Fig. 3. Roentgenogram of patient depicted in Figure 2 after intensive roentgen therapy.

CASE 3. J. F. Lymphosarcoma (igs. 6, d. 1). Th. 53) r. 1d.] h. m. e. t. e. d. the h. o. p. i. t. l. the first time. Th. 11 g. n. t. h. e. l. f. t. d. of the neck. 11 weeks later. At the time of death the patient had a



Fig. 4. Film of patient depicted in Figure 3 after intensive roentgen therapy.

a deep cervical abscess, but further observation showed a paradoxical excursion of the diaphragm on respiration. Roentgenograms showed what was thought to be a mediastinal tumor. He developed acute respiratory embarrassment after the first three roentgen-ray treatments, but it was not necessary to institute oxygen therapy. He was discharged 1 month after admission with reduction in size of the mediastinal mass and of the swelling at the side of the neck.

Roentgen ray treatments were continued for 4 months after discharge, when the patient voluntarily discontinued treatment. Eight months after discharge the patient was readmitted complaining of severe pain at the right costal margin and vomiting for 3 days previously. He applied a mustard plaster to the chest, and developed papules beneath the mustard plaster.

Physical examination on second admission showed poor oral hygiene, with many carious loose teeth, and gingivitis, a fact which was given little significance on his first admission. There was no swelling or glandular enlargement in the neck. The trachea was displaced slightly to the right, and expansion of the right chest was limited. Examination was otherwise negative.

With application of heat and light the pain gradually disappeared. Pustules developed on the area of the papular eruption of the chest, giving the appearance of a typical herpes zoster. The chest plate was negative for bony involvement. No further evidence of tumor could be found. The patient was sent to the dental clinic and several teeth were extracted.

After discharge from the hospital the patient returned for roentgen-ray treatments over a period of 1 year, during which time the pain in the chest decreased, but severe pains developed in the right hip and leg. Roentgenogram showed elevation of the left diaphragm and decrease of 1 centimeter in the width of the mediastinal shadow.

*b Hodgkin's disease* This disease must be considered with mediastinal tumors from the standpoint of differential diagnosis, since it often causes similar symptoms.

While certain prodromal symptoms, such as itching or eczematous eruptions, may be present, enlargement of the lymph nodes constitutes the initial symptom in 50 to 80 per cent of the cases. Beginning most commonly in the cervical nodes, the disease may spread to involve those of the mediastinum, or more rarely they may be the primary seat of the disease.

The enlarged mediastinal nodes may remain discrete or may fuse into a more or less solid mass encircling the great vessels or the air passages. The lungs, pleura, pericardium, cardiac muscle, or liver may be invaded. Enlargement of the spleen occurs in about 10 per cent of the cases.

On the basis of symptoms and physical signs alone, Hodgkin's disease cannot be distinguished from lymphosarcoma, and the diagnosis rests largely on histological examination of excised tissue, and even then differentiation may be extremely difficult. From the standpoint of therapy, however, this is not entirely necessary, as both are usually radiosensitive to a certain

degree. In both, however, recurrence commonly follows, and while life may be prolonged, we cannot speak of cures.

*CASE 9 N G Hodgkin's Disease* (Figs 18 and 19) The patient was a 15 year old boy who had been treated for diabetes with insulin and diet for 2 years previous to admission. Two years before admission, at about the time of the onset of diabetes, the patient first noticed a slight pain at the base of the left side of his neck. This pain soon went away and a swelling appeared. Six months later a painless swelling appeared in the left axilla. During the next 9 months the patient received eight roentgen-ray treatments for these swellings, during which time they gradually increased in size but had periods of remission. During the 8 months following roentgen ray treatments the patient had periods of severe itching, especially of the thighs, and weakness after moderate exertion. No other symptoms.

Physical examination on admission showed an area of dullness in the right lung, and the mediastinum enlarged to percussion. Urine sugar was 4+, fasting blood sugar 84. Roentgenogram of the chest showed a very large mediastinal shadow extending outward from the right hilum and to a lesser extent from the left hilum. Biopsy showed a textbook picture of Hodgkin's granuloma. During his hospital course, the patient's blood sugar was controlled with insulin and diet, the insulin being discontinued after the first day. Sugar in the urine, however, remained 4+ throughout his stay. His temperature remained normal and his pulse moderately elevated and he was asymptomatic. After the diagnosis of Hodgkin's disease was established by biopsy, he received a treatment of deep roentgen-ray therapy and was discharged, to return for further roentgen-ray treatment. Roentgenogram 3 months after discharge showed a definite extension of the process in the region of the right hilum, probably representing a recurrence of the lymphoblastoma. Sixteen months after discharge there was no appreciable change in the size of the process at the right hilum, although the density appeared slightly decreased.

*c Endothelioma* Endothelioma primary in the mediastinal nodes is rare, these nodes being more often involved in the spread of pleural endothelioma. Differential diagnosis can be made only on microscopic examination.

# PRIMARY TUMORS OF THE THYMUS

Benign tumors such as cysts, cystic lymphangiomas, lipomas, or the very rare congenital myxoma, may occur in the thymus, but nearly all the reported primary thymic tumors have been malignant. These neoplasms may originate either in the lymphoid tissue, giving rise to a histological picture resembling closely lymphosarcoma, or in the reticulum cells, in which case the tumor structure resembles carcinoma. Because of the confusion as to their origin, however, recent writers have urged the use of the term "thymoma" to cover all malignant tumors of the thymus.

About 100 such tumors are reported in the literature, of which about 75 per cent have been



## THE REPAIR OF CLEFT PALATES PRIMARILY UNSUCCESSFULLY OPERATED UPON<sup>1</sup>

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EVERY surgeon who performs a fair number of operations for cleft palate encounters a good many individuals in whom the original was or succeeding operations were unsuccessful in that part or the whole of the palate failed to unite. In some cases undoubtedly the operation was improperly performed and thereby union was prevented or even an absolute slough of tissue was caused. In other instances some factor beyond the control of the surgeon may have caused simple failure of union or even a slough. In a series of about 300 different patients operated upon for cleft palate, 141 individuals were found to have been operated upon before, the majority had been operated upon more than once, and some of the patients gave a history of as many as five unsuccessful operations. The average number of unsuccessful operations for the group averaged 2.3 times. Fifteen cases of the group were primarily unsuccessful cases of our own and 126 had previously been operated upon by other surgeons. All of the patients who presented themselves were accepted for re-repair when the age was judged to be correct for the procedure required. In only a few instances was the principle of the operative procedure or procedures used entirely new, but in most instances the technique of the procedures was not that more or less routine with most surgeons and as we gained more experience with the procedures used, or a defect became evident, the various procedures underwent at least a certain amount of refinement or even change.

For purposes of discussion these cases are primarily divided into two large groups (1) the group with little or no loss of tissue and (2) the group with a definite loss of tissue.

### GROUP WITHOUT ABSOLUTE LOSS OF TISSUE

When no absolute loss of tissue was encountered, as is the usual case after failure of a properly performed routine operation for cleft palate, the problem of re-repair was only slightly more complicated than the original operation. Usually the repair of a small midline defect without apparent loss of tissue in either the hard or soft palate

was a relatively simple matter when the surgical fundamentals were observed.

The principle of the Dieffenbach-von Langenbeck operation was in most instances the most applicable to the group with little or no loss of tissue. The lateral incisions of the operation, the loosening of the raphe, and the complete freeing of the mucoperiosteal flaps of the hard palate are capable of allowing a considerable relaxation toward the midline. Although we believe it is important to preserve the palatine artery at a primary operation, at later operations usually this was not found to be of great importance.

When the cleft tended to be unduly wide or the palate unduly short, sectioning of the hamular process which loosens the tension of the tensor palati muscle along with an extension of the lateral incisions both forward and backward and outward toward the anterior pillars aided in obtaining relaxation and possibly tended to cause an eventual slight lengthening of the palate in a backward direction. With this operation some plastic variation to meet the demands of the particular defect often aided one in getting an easy closure or was advantageous to ultimate function if not absolutely essential in gaining midline closure.

When the palate appeared to be unusually short but sufficient tissue was still available to gain good midline closure, the principle of going on backward and uniting the posterior pillars proved of value and often in using the Dieffenbach-von Langenbeck procedure as the essential procedure this addition was added to the standard operation (Fig 1, A). Morestin in 1910, Helbing in 1912, and Mahuen in 1915, in discussing a paper by Emerson, referred to Brophy as having used the posterior pillars to lengthen the shortened velum. Just recently Blair has recommended the procedure after using it for some years. The posterior pillars were found to be progressively easier to sew together in individuals beyond 3 years of age. In our experience, although usually the pillars stayed together when properly sewed, because of the tension there was a certain amount of tendency for separation to occur. A certain amount of this, however, can be eliminated by cross cutting the posterior pillar at its base (Fig 1, B, C). Such incisions, however, added the

<sup>2</sup>This series of cleft palates I do not consider a normal run. The percentage of mutilated palates is remarkably high. Previous to the time this series was started in this vicinity most of the operations for cleft palate defects had been performed by general surgeons who did not make a practice of performing such operations routinely.

<sup>1</sup>From the Surgical Department of the University of Kansas School of Medicine. Presented before the Western Surgical Association, Rochester, Minnesota, December 7, 1935.

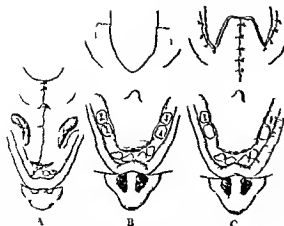


Fig. 1. Dr. Wing's method for closing the posterior palatal defect. A. Initial incision and flap elevation. B. Flaps being pulled together. C. Final closure with sutures.

factor of severance of the palatopharyngeal muscle which probably interfered with function as elevation of the velum was possibly somewhat impeded. In 13 of 19 cases in which it was deemed advisable to stitch the posterior pillars together the pillars stayed together.

Not uncommonly a defect between and back of the clefted alveolar ridge was encountered. A flap from the lip with the base at the midline and raw surface toward the mouth was found to be of value in closing this type of defect. We tried to get a fairly wide base and after raising the ante-

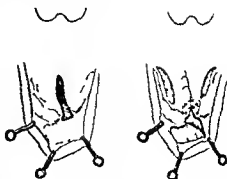


Fig. 2. A and B. Dr. Williams' method for closing the posterior palatal defect. A. Initial incision and flap elevation. B. Flaps being pulled together.

rior hard palatal mucoperiosteal covering, from the ends of the alveolar ridges to turn the lip flap up above the mucoperiosteal flaps in such a manner that a wide overlap of raw surface to raw surface was obtained after careful resuturing (Fig. 2, A, B). The exact figures of the number of times a small anterior flap was used are not available as often the addition of a small anterior flap was made in the purely routine operation, but in 9 patients in whom a somewhat larger flap was used 7 seemed to have the defect closed successfully.

When a second operation was necessary on that type of partial cleft palate which has originally a very thin area about the midline of the hard palate the operation which utilized a cheek flap of mucosa which entirely overlapped the defect in the midline was found to be a procedure of value (Fig. 3, A, B). This operation was originally designed to give more length to the palate although it was concluded that for this purpose the procedure was of only relative value. As a plastic procedure to supplement the likelihood of union it was worth while.

#### GROUP WITH LOSS OF TISSUE

In the group of patients with more or less absolute loss of tissue the defects were found to be quite variable and presented quite unique problems when a repair was effected successfully. Very roughly these patients presented defects which fell into one of two or even three of the following groups: (1) a large midline loss in the central part of the hard palate; (2) a loss of a part or most of one of the flaps of the hard palate; (3) a hole in the anterior or lateral palate which was

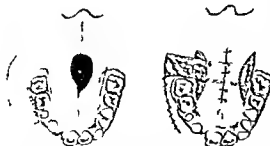


Fig. 3. A and B. Dr. Williams' method for closing the posterior palatal defect. A. Initial incision and flap elevation. B. Flaps being pulled together.

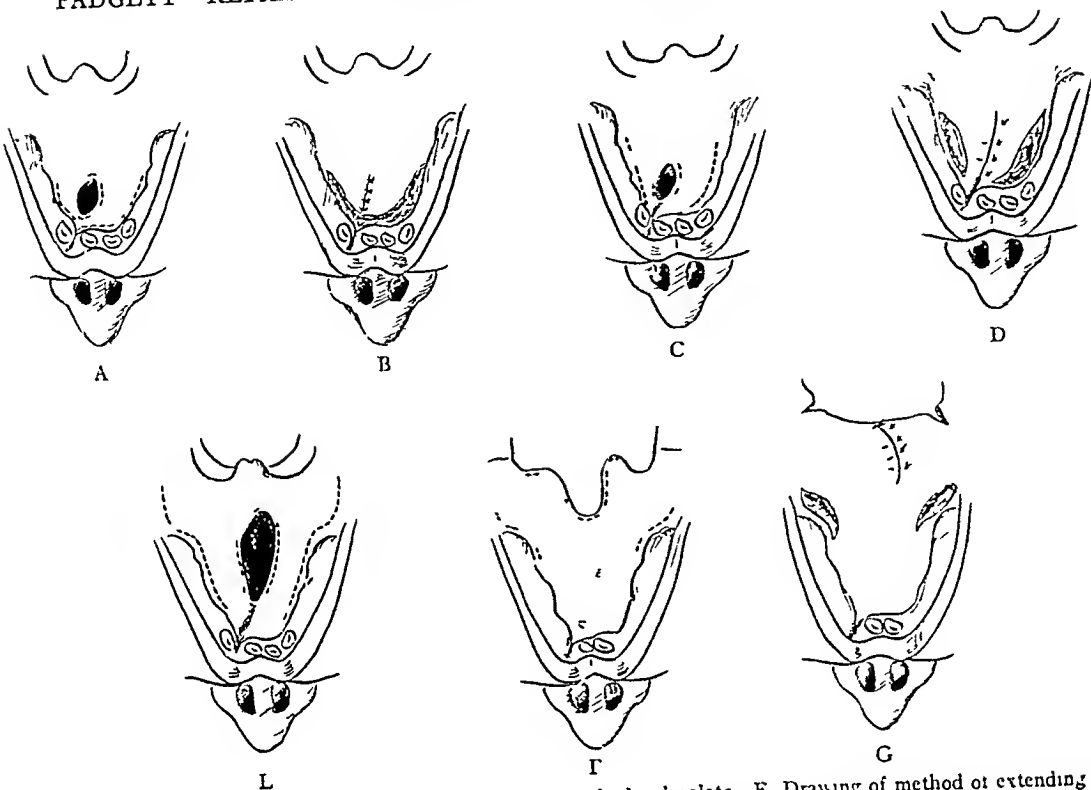


Fig 4 Drawings of midline hole in the anterior palate region corrected by a modification of the Dieffenbach von Langenbeck principle. A and B, Mucoperiosteal flap detached anteriorly. When this is done it is usually wiser to add the additional support of an anterior mucosal lip-cheek flap (Fig 2, A, B) or one will more than likely get a hole next to the alveolar defect. C and D, Midline anterior defect closed by use of long lateral incisions without detaching the anterior extremities of the mucoperiosteal flaps of

the hard palate. E, Drawing of method of extending the lateral incisions to give additional relaxation to the midline and possibly some additional length. When a lateral cheek flap crosslaps the middle of the upper surface as shown in Figure 3, A, B, C, greater length is likely to be the final outcome. The crosslapping flap also reinforces the midline suture line. F and G, Drawings of the method of using the velum of the normal or nearly normal side to fill in a defect of the velum on the opposite side.

adjacent to the alveolus from which the mucoperiosteal covering has been lost, (4) a large defect at the hard palate-soft palate juncture, (5) a considerable loss of soft palate tissue, and (6) an almost complete loss of the tissues of the hard palate.

1 *Large midline loss in the hard palate.* When the midline loss was only of moderate proportions it was found possible to use a modification of the Dieffenbach-von Langenbeck operation with a fair degree of certainty of obtaining closure. When the hole was anterior, an interior flap from the lip or cheek with mucosal surface turned toward the nasal cavity was of value, especially if it was necessary to loosen both ends of the hard palate-lip anteriorly (Fig 4, A, B plus Fig 2, A, B). Usually it was considered much the better if possible to close an anterior midline defect without

detaching the hard palatal flaps at the extreme anterior end (Fig 4, C, D). When the hole was unilateral it was sometimes advantageous to loosen one flap well forward anteriorly—even completely if the situation demanded it. Often by making long lateral incisions next to the alveolus, sufficient relaxation was obtained to allow closure of a hole of considerable size (Fig 4, L). When the likelihood of union seemed particularly dubious, reinforcement of the suture line by crosslapping a cheek flap above the palatal flaps added certainty to a successful outcome (Fig 2, A, B). In 15 cases in which a lateral flap of the cheek was added to supplement the likelihood of union, closure was obtained in 13 instances. When a part or one side of the velum had been lost, another variation of the Dieffenbach-von Langenbeck principle was advantageous in closing a uni-



Fig 5 A and B Drawings of the method of closure of lateral hole in hard palate. In both some mucoperiosteal flap is shown with a turnover flap. In A the flap is turned over the raw surface. In B the flap is sutured to the raw surface.

**lateral posterior defect of the velum** The method consisted of pulling the nearly normal side of the posterior velum over to the defective side after which the normal side was sewed up onto and backward of the defective side toward the lateral pharyngeal wall (Fig 4 F G)

In an occasional case especially when the hole was somewhat lateral the principle of the Lane operation very occasionally offered advantages (Fig 5 A B) As is well known in the Lane principle a flap is outlined and turned over beneath an opposite flap. When the principle was used successfully it was found that a good blood supply at the base of the turnover flap had to be present and sufficient width and length so that a wide overlap was gained.

2 **Loss of a part or most of one of the mucoperiosteal flaps of the hard palate** Only occasionally was a patient encountered in whom the only essential defect was a slough of one of the flaps of the hard palate. Usually when this defect was found the posterior part of the palate also had sustained severe damage. When only a mucoperiosteal flap of the hard palate was absent a repair with a fair type of success in one operation was found to be possible by using a relatively long and broad cheek flap (Fig 6 A B) Whether the flap was turned from before backward or from the posterior end forward depended upon where the maximum defect was encountered. Ordinarily it was believed that when an anterior cheek flap was indicated greater likelihood of union was obtained if the mucosal side of the flap was turned toward the nose. When using this procedure it was considered essential that a fairly broad base and as broad an overlap of raw tissue as possible was

obtained. The flap then was sewed into place with the greatest of care. When the posterior part of the lateral mucoperiosteal flap of the hard palate was absent flaps of the Lane type were turned to the center of the defect. A lateral cheek flap was then cross lapped over the raw defect. Every effort was made to obtain wide apposition of the raw surfaces when the cross lap was made (Fig 6 D E).

When a defect of the soft palate was a complicating factor to the loss of one hard palate flap we succeeded in cases in obtaining a good palate in one operation by either turning a cheek flap from before backward or using a lateral cheek flap along with a posterior pharyngeal flap turned forward above the palate. After the child has attained the age of 8 or 10 years by cutting an anterior flap and a posterior pharyngeal flap properly the flaps can be made to meet at their respective tip ends. The ends were then stitched together and both flaps sewed in carefully above the remnants of palatal tissue which remained (Fig 6 A B). If the cheek flap was cut too narrow the procedure was seldom successful. When the base was made anteriorly due regard was paid to the scar if the lip had been repaired previously. When the lateral cheek flaps were used care was taken not to remove too much of the mucosa near the posterior angle of the cheek, and it was found that one can remove a considerable width of mucosal flap lengthwise of the cheek without noticeable impairment in opening the mouth. Later the base of the flap was rearranged when necessary. When the cheek flap was cut if width was an absolute necessity to assure an adequate blood supply or to obtain a wide overlap when the defect was closed we ignored the papilla of the parotid duct. No ill effects after its removal were observed. The combination of an anterior cheek flap or a lateral cheek flap along with a posterior pharyngeal flap offered a one stage procedure which was useful in the middle adolescent period in obtaining closure in one operation of a large defect of both the hard and the soft palate.

When cheek flaps of these types were used to bridge a rather large gap the flaps closed the hole in 7 of 9 cases but in only 2 cases was all of one mucoperiosteal flap absent.

3 **A hole in the anterior palate or lateral palate which is directly adjacent to the alveolus** In a few instances this type of hole was found to be impossible to close. When the hole was not large it was found possible sometimes to gain closure by cutting a thin lengthwise flap from the wider and thicker of the two palatal flaps. This flap included only one half the thickness of the palatal



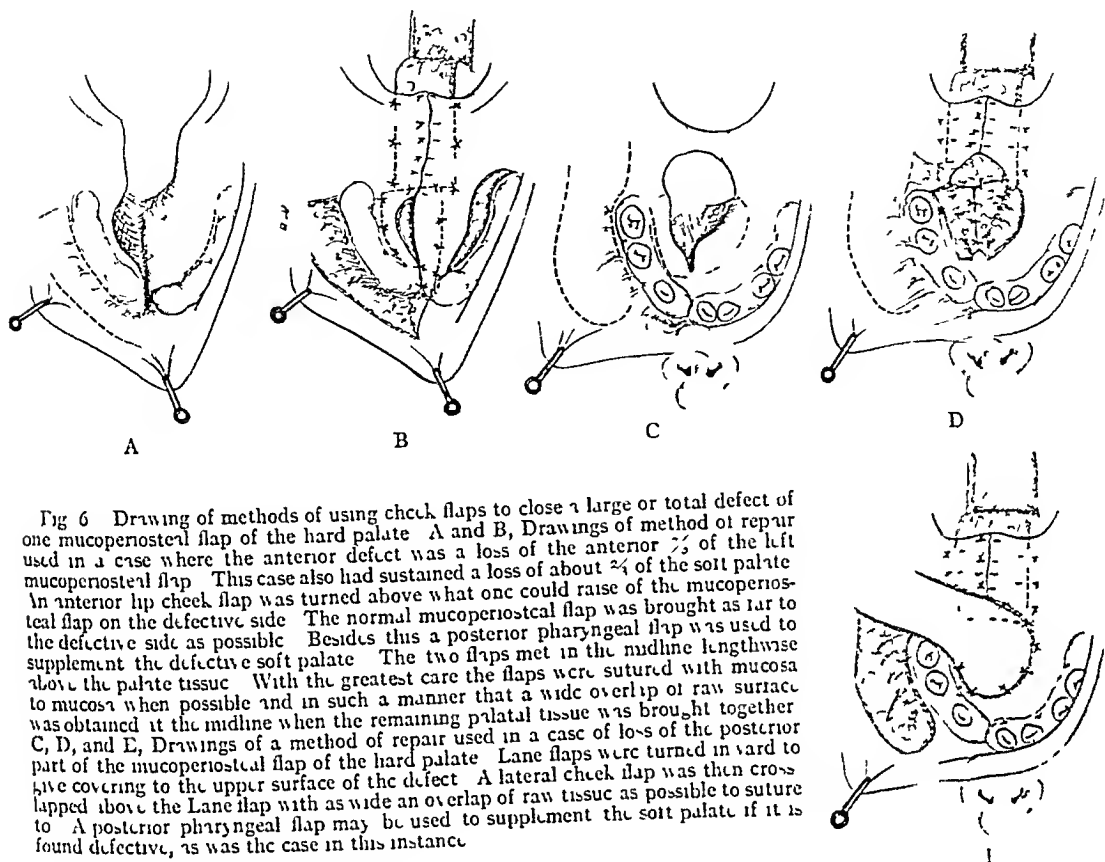


Fig 6 Drawing of methods of using cheek flaps to close a large or total defect of one mucoperiosteal flap of the hard palate A and B, Drawings of method of repair used in a case where the anterior defect was a loss of the anterior  $\frac{2}{3}$  of the left mucoperiosteal flap. This case also had sustained a loss of about  $\frac{3}{4}$  of the soft palate. An interior lip cheek flap was turned above what one could raise of the mucoperiosteal flap on the defective side. The normal mucoperiosteal flap was brought as far to the defective side as possible. Besides this a posterior pharyngeal flap was used to supplement the defective soft palate. The two flaps met in the midline lengthwise above the palate tissue. With the greatest care the flaps were sutured with mucosa to mucosa when possible and in such a manner that a wide overlap of raw surface was obtained at the midline when the remaining palatal tissue was brought together. C, D, and E, Drawings of a method of repair used in a case of loss of the posterior part of the mucoperiosteal flap of the hard palate. Lane flaps were turned in ward to give covering to the upper surface of the defect. A lateral cheek flap was then crosslapped above the Lane flap with as wide an overlap of raw tissue as possible to suture to. A posterior pharyngeal flap may be used to supplement the soft palate if it is found defective, as was the case in this instance.

flaps. The upper flap was then slid over to the remnant of a flap raised from the alveolus. In several instances an attempt was made to close such a defect by one type of plastic or another but when one was unable to raise sufficient mucoperiosteum from the alveolus to get a ledge of tissue to sew to, such procedures were not successful ordinarily in our experience. Therefore, in such a situation, a prosthesis to plug the hole was recommended (Fig 7, A, B, C, D). In 3 cases such a prosthesis was considered necessary to plug a hole of no great size. Very often a bridge is necessary when the alveolus is cleft in way.

4. *A large defect at the hard palate-soft palate junction.* By making long lateral incisions and extending them well back and thoroughly freeing the lateral palatal flaps, a rather large defect at the hard palate-soft palate junction was usually closed without undue tension at the midline (Fig 4, E). Generally the hamular processes were broken inward to obtain all the relaxation toward

the midline possible to gain. As an addition to the preceding operation, in children after 4 or 5 years of age, especially when the palate is short or there is some question of union, a unilateral cheek flap was found to be of value (Fig 3, A, B). The cheek flap was drawn through the lateral incision and crosslapped above the palate. The end of the flap was sewed to the outer edge of the opposite flap. The flap was very carefully sutured so that the whole width and length was utilized, by through and through sutures. Thereby the midline suturing was reinforced by crosslapping the flap above. When lateral incisions have been made at some previous time, the base of the flap was cut a little farther from the alveolar check sulcus. A lateral flap of this type is used in 15 instances to overcome this situation and in 15, the hole is closed. This procedure seemed to be of particular value in this particular type of defect.

*Summary of Results of the Longitudinal Cheek Flap Operation.* In Table I is given a brief summary



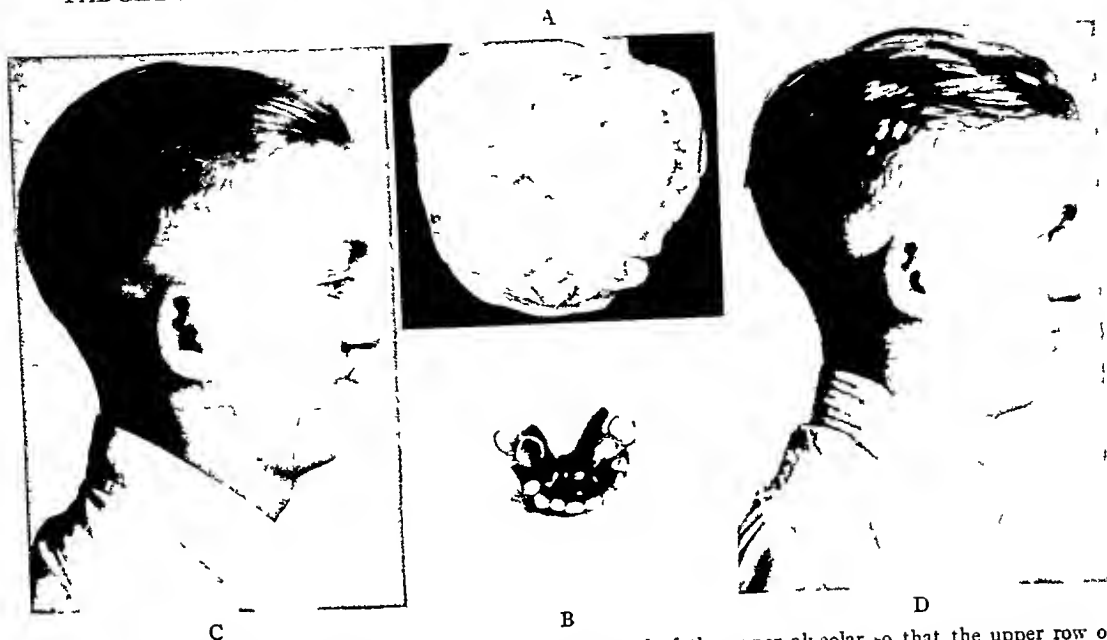


Fig 7 A, Cast of upper jaw and palate with hole anterior and next to the alveolar ridge B, Plate made to plug the hole with clasps attached to the teeth C, Lateral view of patient without plate in mouth D, Lateral view of patient with plate in mouth The plate is built somewhat

forward of the upper alveolar so that the upper row of teeth fall forward of the lower row The upper lip is held forward by the prosthesis, giving a normal profile relationship to the two lips

will be experienced in sewing the flap in above the soft palate but, after doing the operation a few times, the difference is one of only a slight degree For the purpose of closing a soft palatal loss which was not likely to be closed in any other manner, we have found the operation to be an unusually efficient one After a few weeks the pedicle of the flap rolled into the form of a tube and breathing was not impeded as a rule Ordinarily the pedicle was left attached for a variable period of time and then cut But in three instances in which we cut the pedicle away from the pharynx we were asked by the patient to reattach it as speech seemed to be better with the pedicle attached By the use of a right angled knife and any short general anesthesia, or for an adult local anesthesia, the flap was found to be easy to cross cut

The disadvantage of leaving the pedicle attached was found to be most noticeable during an acute cold Otherwise by the use of saline nasal irrigation morning and evening the tendency for the accumulation of nasal secretion in the nasopharynx was minimized to only the slightest of noticeable symptoms There have been performed 68 posterior pharyngeal flap operations for the purpose of closing this type of defect In a few instances the operation was done in children as

young as 3 years plus The average age was 11 years plus In 7 a cheek flap was deemed necessary to supplement the primary posterior flap procedure In 52 cases complete closure was obtained In 3 the palate broke down, in 4 one side partially broke down, and in 7 there appeared at the soft palate-hard palate juncture a hole but the posterior part of the palate was closed A lateral cheek flap we believe would have supplemented and added to the chance of union in those cases but at that time we did not appreciate the uses of a cheek flap Two patients died, 1 of pneumonia with the onset 10 days after the operation, and 1 of an edema and cellulitis of the pharynx 24 hours after operation The latter death occurred in a child about 3 years of age and warned us to be careful with the operation at this age The functional results were quite good In 10 the speech was remarkably improved to nearly normal, in 27 the speech was fair, in 18 improved but not good, and in 4 unimproved (Table II)

This operation has been criticized on the basis first that the scarring of the posterior pharynx would interfere with the function of Passavant's pad and the action of the superior constrictor muscle of the pharynx, and second, that it prevented adequate drainage and ventilation of the

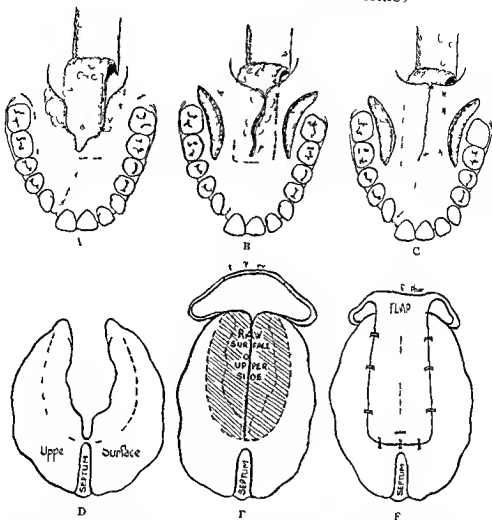


Fig. 8. A. The pharynx and larynx. B. The pharynx and larynx. C. The pharynx and larynx. D. The pharynx and larynx. E. The pharynx and larynx. F. The pharynx and larynx.

nasopharynx. In the type of case for which we have used the operation the advantages of soft palate closure in an efficient manner has proved to be considerably greater than the disadvantages of interfering with the function of the upper part of the superior constrictor muscle.

In evaluating the position of the operation we believe that it has only one useful function. It is

not of much value for the atrophic palate. The operation offers a one stage operation that will allow one to close successfully a defective soft palate that one could hardly hope to close otherwise (Fig. 9 A B). When distinctly held to this position although it may not be physiologically the ideal procedure it will allow one to close a very large defect of the soft palate in the majority

of cases and when the extent of the defect is considered will result in a surprisingly good functional result. The practical effects of the disadvantages of the operation are not very important in comparison with the advantages of the operation.

In our series are no records of a sinusitis being aggravated by the operation. Middle ear infection has not been noted to have been increased. When there was evidence of interference with free breathing or insufficient drainage of the nasopharynx, the pedicle of the flap was severed, after which these symptoms were not present. In a good many others although these symptoms were not complained of, the pedicle was cut to be on the safe side.

6. *Almost complete loss of both the hard and soft palate.* In this series were 9 individuals in whom the hard and the soft palates had been almost completely lost and who were considered old enough to withstand without too great danger a repair by the use of extrapalatal tissue. Of this group of 9, 7 had double complete cleft of the palate. In 8 the palate was successfully rebuilt. In 1 the soft palate alone was rebuilt. In 6 both the



Fig 9 A, left, Photograph of typical case in which the posterior pharyngeal flap operation is indicated. B, Photograph of the patient after use of posterior pharyngeal flap.

soft and the hard palate were rebuilt. In 2 the soft palate was rebuilt by the means of a posterior pharyngeal flap and the hard palate was rebuilt by the use of extra-oral tissue. In 1 the flap remained attached to one side only and the attach-

TABLE III—EXTRAPALATAL FLAP CASES OVER 7 YEARS OF AGE

Name	Age Yrs Sex	Date	Cleft	Material used	Anatomical result	Functional* result				Complications
						0	1	2	3	
Lesh	16 F	1928	Partial cleft	Arm flap direct	Success		1			Some respiratory distress 24 hr
Duncan	21 M	1929	Double cleft	Arm flap direct	Success				1	Respiratory distress Tracheotomy necessary
Dix	7+ M	1931	Double cleft	Neck flap jump to lip	Success			1		Flap came loose from palate None beneath lip
Jones	9 M	1932	Double cleft	Arm flap direct	Success			1		None
Sapp	19 M	1932	Right complete cleft	Arm flap direct	Partial failure Epilepsy	1				1 Epilepsy unknown to us until in midst of operation 2 Tore off cast in epileptic fit
Macklin	16 F	1933	Double cleft	Arm flap direct	Success				1	None
Poague	10 M	1933	Double cleft	Arm flap direct	Success			1		None
Filbert	10 M	1934	Double cleft	Posterior pharyngeal flap jump to lip	Success			1		None
McDowell	5 F	1935	Double cleft	Posterior pharyngeal flap Arm flap	Success			1		None
	13+					1	1	5	-	

Average age 13 plus Youngest 7 years Oldest 21 years (best result) Seven of the 9 cases were double clefts—1 partial—1 single

\*3—remarkably improved to nearly normal

2—fair

1—improved but not good

0—unimproved

Note: Very early in our experience at the insistence of the parents we attempted to build in a palate with a jump flap beneath the upper lip from the neck, thinking this the least severe way of building in a palate completely to it. The child was 2 1/2 years of age. He died weeks after the flap was reversed into the palate. This child should not have been operated on in this manner at his age. This case makes 10 cases attempted but is not included in this series because the age was an unjustifiable one in our opinion.

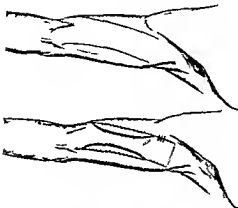


Fig. A and B



Fig. C D



Fig. E



Fig. F



Fig. A. L. f. c. ion. a. m. bel. th. fl. p. raised. d. t. bed. B. Th. fl. p. h. bee. d. and. t. bed. A. f. l. th. kn. ss. k. graft. h. be. rem. ed. f. m. th. bel. m. and. t. uth. n. th. w. d. f. c. t. th. p. p. e. d. f. th. fl. j. B. th. th. p. p. e. d. l. th. fl. p. ne. a. ly. sq. re. flat. th. t. n. t. l. m. d. l. g. m. p. e. t. has. bee. h. ap. ed. A. p. l. t. g. f. t. f. m. th. th. g. h. s. be. draped. e. both. des. f. th. t. n. t. The. t. t. th. se. ed. f. a. th. the. p. p. e. r. d. f. th. flap. so. th. t. p. th. l. l. n. g. g. n. t. th. d. f. l. th. p. p. e. d. f. th. flap. Th. w. f. c. f. t. m. be. e. th. t. p. e. r. d. f. th. fl. p. l. so. p. th. l. a. e. d. sim. l. r. w. y. Th. t. n. t. r. m. ed. n. o. d. y. s. A. l. e. q. t. s. e. l. g. e. d. r. e. s. g. p. l. a. e. d. th. p. e. t. w. l. th. at. t. l. l. g. e. d. l. y. About. 3. w. e. k. f. t. th. p. e. r. a. t. g. f. t. l. l. o. c. l. est. h. e. s. i. a. th. p. e. r. d. f. th. flap. cut. d. est. t. e. d. d. p. l. a. A. s. so. o. s. th. m. f. l. y. (th. flap. t. a. n. may. go. a. l. t. r. a. n. s. f. th. fl. p. t. th. m. th. C. Lat. al.

sh. l. l. p. ved. A. t. f. the. k. g. f. t. cut. y. th. s. d. e. s. f. i. th. d. p. Th. fl. p. a. t. r. n. f. red. t. m. th. d. r. y. c. a. f. l. y. t. u. ch. d. b. y. d. l. l. f. l. g. i. t. r. u. p. t. d. t. h. e. s. e. o. t. b. t. n. d. e. e. p. d. p. e. f. l. l. t. m. t. f. r. a. r. f. c. e. l. th. p. o. s. t. p. a. l. t. r. e. n. e. s. p. e. c. i. a. l. ly. s. o. f. f. t. m. l. t. r. e. t. d. r. a. s. l. p. f. r. w. f. s. o. th. i. th. fl. p. l. l. t. b. e. j. d. d. t. l. n. f. w. t. a. n. c. e. s. d. g. m. y. h. a. t. b. e. j. d. d. b. e. c. e. th. t. e. a. t. h. p. i. b. t. g. f. i. th. fl. j. f. m. t. t. b. e. y. t. h. e. s. e. r. e. l. l. y. d. l. l. f. t. th. p. e. r. e. t. h. s. u. n. p. e. f. t. s. o. t. u. a. t. d. th. a. t. l. l. l. t. l. d. g. d. l. l. t. l. a. d. m. t. A. d. e. q. t. m. t. f. f. l. m. y. b. e. p. l. a. c. e. d. l. t. l. h. d. l. h. l. m. l. s. t. t. t. t. r. e. s. t. l. r. Fig. A. f. l. l. l. e. g. l. f. l. t. f. t. r. h. p. h. e. e. t. f. m. th. a. r. m. l. t. e. d. h. t. th. l. p. m. o. s. a. l. t. h. p. a. t. i. s. m. h. d. m. e. d. t. p. r. e. m. i. l. l. t. f. e. m. p. e. r. a. t. B. D. e. n. t. a. l. p. l. t. b. l. t. l. l. d. th. p. e. l. p. f. d. d. t. g. n. r. m. l. l. t. e. e. t. h. th. s. a. m. p. a. t. i. e. n. t.

ment to the opposite side has not as yet been completed. One other case (tenth case) was attempted when our experience had been very meager due largely to in-istence of the parents. The child was

2 years of age. A juncy flap was turned from the neck up beneath upper lip. The child died 2 weeks later after flap was turned into palate. For this operation the child was undoubtedly too young.



Fig 12 A, Photograph of patient in whom a palate was afterward built by extrapalatal tissue and the lip and nose were repaired. Front view. B, Profile view. C, As much of new palate as could be shown in a photograph, 2 months after operation. D, One year later after final repair and building of a prosthesis. This patient got an almost perfect result. His speech was good. His appearance was corrected by a prosthesis to hold the lip forward. His nose and lip were straightened. Profile view. E, Front view.

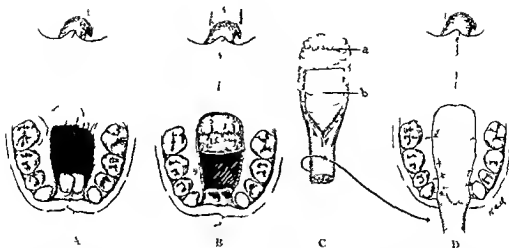


Most of the previous literature concerning the repair of gross palatal defects with extrapalatal tissue has been cited in another article.

The idea of the repair of a palatal defect by a flap from elsewhere than inside the mouth is rather ancient. It was first unsuccessfully attempted by Blasius by the use of a flap from the neck. Thiersch, in 1867, and Rotter, in 1869, used the principle successfully. Later the method was successfully used by von Eiselsberg and Blair. Coughlin also has repaired a hard palatal defect of this type by the use of a cartilage transplant.

As experience was gained with operations using extrapalatal tissue, our opinion as to the indications for the operation has gone through somewhat of a transition. Controversy as to whether or not one is justified in building in a defective palate with extra-oral tissue naturally tends to make one view the results with a highly critical attitude. As only a few of these operations have been performed in the past, before the procedure can be judged on its merits a certain amount of experience along with a refinement of technique would appear to be necessary (Fig 10, A,B,C—Fig 11, A,B). The mere operation, although a tedious one, is not particularly dangerous when one is capable of its execution. The main danger was found to be difficulty in swallowing the

saliva which may result in respiratory aspiration during the first 48 hours. This danger can be largely eliminated by not stitching too thick, too wide, or too long a flap into the pharynx and by being careful about propping the mouth too widely open to keep the flap from being bitten in two. Patients with the mouth propped open too widely swallowed with difficulty. Often this difficulty will not be encountered because practically all of the cases will be found to have double cleft of the palate and the premaxillary teeth are in such a position or condition that danger of biting the flap in two is negligible. In the earliest cases the mistake was made of tubing the part of the flap which was to be inserted into the mouth. Such a flap was too thick for the best ultimate result and much more difficulty was experienced in sewing it into the palatal ledge. A flat flap



1. A. M. Th. du. g. p. i. pharyng. flap. a. c. m. b. a. th. t. p. l. s. p. A. Th. p. o. t. r. i. l. t. e. h. i. n. p. a. i. d. b. y. t. h. u. e. f. i. s. h. p. t. e. r. i. p. h. a. r. y. n. g. i. d. p. m. t. h. o. d. Th. flap. i. b. e. u. s. e. d. h. t. h. a. i. m. p. d. p. f. r. m. t. h. a. b. d. o. m. o. r. a. r. m. f. l. a. p. s. p. e. d. Y. e. n. t. h. e. p. o. t. e. r. i. o. r. p. l. a. t. e. i. s. p. d. A. f. t. r. s. e. h. t. e. t. r. a. p. a. l. t. a. i. f. l. a. p. t. o. t. h. a. t. e. p. l. t. B. A. l. d. g. e. s. t. u. r. n. e. d. f. r. o. a. d. f. o. m. t. h. s. o. f. t. p. a. l. t. e. s. o. t. b. i. a. s. d. o. e. l. p. T. h. e. m. a. g. n. i. t. u. d. e. o. f. t. h. e. p. a. l. a. t. e. m. u. c. p. e. r. i. o. t. e. l. l. a. p. s. l. e. v. e. l. e. d. f. o. m. t. h. t. r. d. C. D. a. g. m. f. l. a. p. a. f. t. i. s. e. t. b. e. f. e. b. g. u. t. h. d. a. t. t. h. d. f. e. c. t. R. a. s. u. r. f. e. b. p. l. t. g. f. e. D. Th. f. l. a. p. b. e. n. t. i. t. h. e. d. n. t. t. h. d. f. t. E. v. e. r. y. a. t. t. e. m. p. t. a. m. d. t. g. t. d. p. p. u. a. t. n. o. f. s. f. e. e. s. A. p. l. t. g. r. a. f. t. c. s. t. h. p. p. r. i. c. W. h. t. h. p. l. t. n. d. r. f. a. z. i. o. n. n. t. h. l. p. l. i. u. u. e. s. o. t. h. t. p. t. h. e. s. a. n. b. f. i. l. l. e. d. t. g. a. a. o. r. m. l. f. t. e. e. t. h. d. h. i. d. i. t. e. l. p. f. o. r. w. a. r. d. t. h. e. i. d. o. f. t. h. e. f. l. a. p. b. i. c. t. f. m. i. s. b. a. s. e. c. a. n. b. s. e. d. f. t. h. s. p. r. o. s. e.

with a skin graft on the opposite surface was easier to set in place with the required width of raw overlap necessary. Up to the mouth the flap had better be tubed so that a flap long enough with a good blood supply is obtained.

In 2 of the 6 cases in which the whole palate was rebuilt the functional result was improved to nearly normal (Fig. 12, A B C D E). In 4 the functional result was listed as fair (Table III).

As experience was gained in using the posterior pharyngeal flap operation to aid in closing a large loss of the tissue of the soft palate the possibility of a combination of the posterior pharyngeal flap procedure for the soft palate when sufficient tissue was present and an extra oral flap with which to build in the hard palate occurred to us (Fig. 13, A B C D). In 2 recent cases this has been the procedure used. The use of the extra oral tissue for building in the hard palate alone was a much less severe procedure than for building both the hard and the soft palate. The soft palate was built in at the time the extra oral flap was prepared several weeks previous to placing the flap in the mouth. After this procedure the patient swallowed easily immediately and had no difficulty with respiration. The only uncomfortableness was due to the head cast and the fixed arm.

The operation of first jumping a flap beneath the upper lip was used in two instances and it was found to be less trying on the patient than building in the palate directly (Fig. 14). In 1 case it was necessary to release the upper lip so as to obtain an epithelial lined wall anyway for the purpose of inserting a prosthesis which could be used to hold the lip forward. In the other case the flap was immediately titched in beneath the upper lip after it had pulled loose from within the mouth and at a later period reversed into the mouth and thereby the day was saved.

Butter criticism has been leveled at the operations which use extrapalatal tissue for the reconstruction of gross palatal defect. Veau states that such operations are never indicated and has called them "urgiculous monstrosities." He has also stated that the defect corrected is of less consequence than the defect left after the reconstruction and finally that a prosthesis is preferable to any extra oral tissue reconstruction. Dorrance takes a somewhat similar position.

Since plastic surgery has undergone the development it has in more recent years operations similar in principle are of common occurrence in the hands of good plastic surgeons. The repair of gunshot defects or defects after operations for



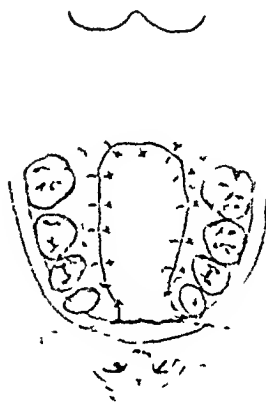
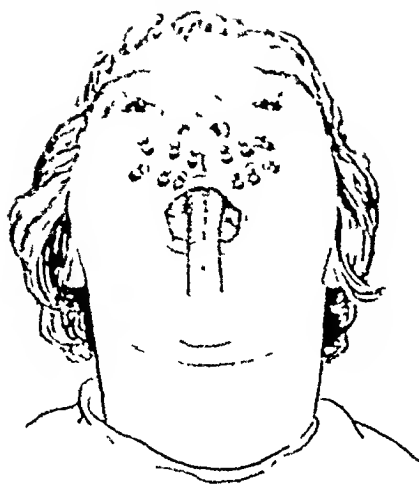


FIG. 14. When it is necessary to free the lip from the alveolus so that a prosthesis may be used to hold the upper lip forward to improve the appearance one may jump the flap beneath the upper lip first and later turn it backward into the anterior palatal defect. Also if for any reason the flap originally sutured into the mouth does not hold one can immediately suture it beneath the upper lip and then later jump the flap back into the palatal defect. The most common reason for an extrapalatal flap being torn from the mouth is too much tension either from shortness of the flap or improper application of the arm head fixation. In one of our patients who was an epileptic and it was unknown to me a flap was pulled out during a "fit."

malignancy no worse than this congenital defect when repaired by these methods are pointed to with pride.

The defect which remains after an arm flap is used is negligible when the flap is taken from the medial side of the arm and a good "take" of the skin graft is obtained. In the event if one prefers because of the scarring of the arm a "jump" flap from the abdomen may be used which does not leave an arm scar but one more operative step is entailed when this method is used.

Complete prosthesis for the unfortunate victim of cleft palate is not as a rule satisfactory. Our series contains 9 examples in which the prosthesis was either built for us or was built by various dentists before we saw the patient. In none of them has the prosthesis been satisfactory and only 2 of them use the prosthesis more or less continuously. Prosthesis to plug the gap of a hard palate cleft alone after the soft palate was built in, can present a much stronger argument as to efficiency than can prosthesis in a total defect of the palate. However, the 2 cases in which we have reconstructed the hard palate with extrapalatal tissue after building in the soft palate with intra-oral tissue have been happy with the result. Usually the efficiency of the prosthesis is somewhat directly proportional to the size of the defect which

it closes. Prosthesis to plug a small hole is more efficient than prosthesis for placing a diaphragm across a large defect. The advantage of having a permanent diaphragm of living tissue between the nose and the mouth and of not having food pass into the nose is considerable, notwithstanding the fact that a prosthesis for a defect in the hard palate alone may aid defective speech as much, or almost as much as a permanent soft tissue diaphragm.

#### CONCLUSION

In conclusion, one might say that it is extremely rare that an individual with cleft palate unsuccessfully operated upon is seen in whom if the proper time is selected for the operation which is indicated in a given condition, cannot be offered a good deal of improvement, and in some cases the final result will be found to be about as good as if he had gained primary union at the first operation. The problem is to individualize the patient, the condition found, and to select the procedure which, when all factors are considered such as the age of the patient, likelihood of union, number of operations required, and the size of the defect, offers the most reasonable and the nearest to the ideal anatomical and functional repair under the conditions encountered. The posterior pharyngeal flap operation is a satisfactory operation when

used to aid in obtaining union and giving length to a soft palate in which the tissue loss has been considerable. As far as the proposition of prosthesis versus the transplantation of extrapalatal tissue is concerned the question may be decided when 2 conditions are fulfilled first whether or not the patient or those responsible wish the palate built in after the advantages and disadvantages of both methods have been explained and second if the operation is decided upon whether or not the operator can do the operation. The procedure is certainly not one to be recommended to all surgeons with whole heartedness but in good hands it is not at all an unjustifiable procedure. Usually it is in the patient in whom the damage has been considerable and in whom the palate has been repaired just barely acceptably but too well to justify more radical methods that one really sees the poorest functional results.

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# A SIMPLE METHOD OF AMPUTATING EXTERIORIZED BOWEL WITH THE CARR HILAR LOBECTOMY CLAMP

## A MODIFIED SECOND STAGE MIKULICZ OPERATION

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THERE are several different methods of amputating the exteriorized bowel after the first stage of a Mikulicz operation for carcinoma has been performed. For the second stage operation, we have employed the Carr hilar lobectomy clamp (Fig 1a)<sup>1</sup> and have found that it simplifies the procedure and reduces the morbidity.

Usually the second stage of the Mikulicz operation presents no great technical difficulties, yet occasional complications or even death have followed its performance. The practice in most clinics is to amputate the bowel by actual cautery, which may be done in the operating room or with the patient in bed. The procedure subjects the

patient to an additional hazard during a critical period, when slight manipulation or trauma may cause shock. Resection by actual cautery is often accompanied by considerable bleeding. This necessitates clamping and ligating vessels in the bowel wall and mesentery, such a procedure is shocking to a patient who 36 or 48 hours previously has undergone an extensive operation. Then too, the edematous tissues and engorged veins so frequently encountered tear easily when clamps are applied and sutures are introduced. Occasionally, while handling the bowel, the mesentery separates or splits down into the peritoneal cavity, and thus allows soiling with intestinal contents.

Many surgeons combine the first and second stages of the Mikulicz operation. Intestinal

<sup>1</sup>Carr, D. Automatic hilar ligature for lobectomy. *J Thoracic Surg.*, 1935 4 327, 328

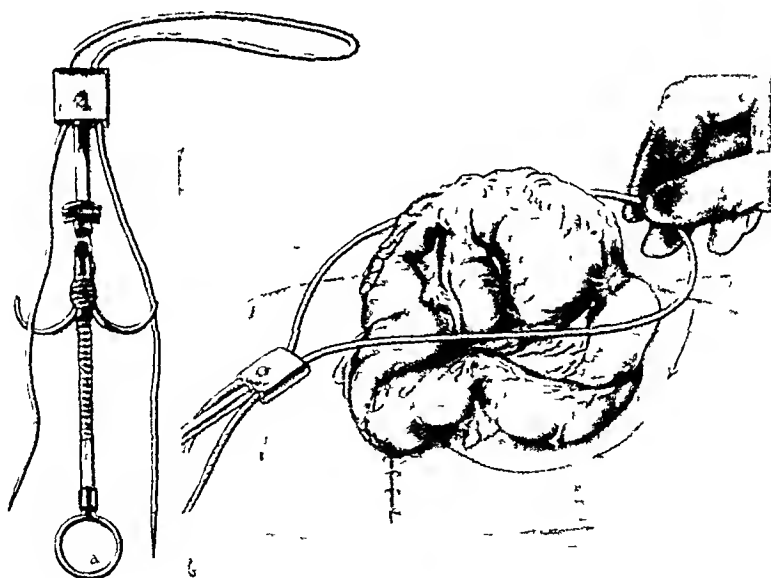


Fig 1 a The Carr ligature clamp with a cord threaded through the head which contains two double one way ratchets. The detachable handle is screwed onto the locket. The handle has a long ratcheted shaft to take up slack when the tourniquet is tightened with the sliding grip. b The tourniquet is passed over the exteriorized loop of bowel. The cord is tightened around the double barrel of gut at least an inch above the skin surface.

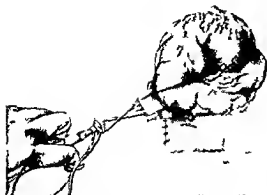


Fig 2 After the strings been fixed to the calf on the cross bar the tumor is straightened by pulling down the handles

crushing clamps are applied and the bowel distal to the clamps is amputated. This step represents a change from the original method but certain complications may develop. First no matter how carefully the wound is closed and sealed before the tumor bearing loop is removed a severe wound infection or peritonitis may occur. Second the patient often suffers definite pain and

discomfort from the pull of the clamp on the bowel and their weight on the abdominal wall.

Fortunately the complications mentioned are not of frequent occurrence. However a review of a large series of operations will disclose that a few patients might have recovered had such difficulties not followed the second stage of the operation.

Amputation of the bowel with the lobectomy clamp mitigates many of the disadvantages of the methods so generally used. The operation is done at the bedside making transportation to the operating room unnecessary. Since the amputation is performed with complete compression of the mesenteric vessels and the vessels in the wall of the bowel bleeding does not occur. Compression of the two loops of bowel by the string removes the danger of a tear or separation of the attached and agglutinated mesenteries. Furthermore the patient suffers practically no discomfort as only the lock and string snare rest on the abdominal wall.

The first stage of the Mikulez operation need not be so extensive a procedure when this type of second stage operation is carried out. Since hemostasis is obtained by constriction with the lobectomy clamp it is unnecessary during the first stage operation to cut and ligate as many

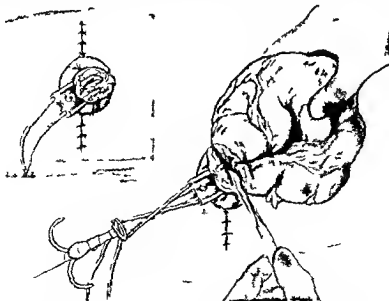


Fig 3 The loop of the string is cut with a scalpel. The appearance of the abdomen has been completed. The handles of the string are detached leaving the lock and string in position.

vessels in the mesentery, particularly those involved in the neoplastic process

The technique of amputation with the lobectomy clamp is illustrated in the accompanying sketches. The clamp is applied 30 to 48 hours after the first stage operation. The ligature is placed around the bowel at least an inch above the skin surface (Fig. 1b). After applying the clamp as tightly as possible (Fig. 2), amputation of the distal loop of tumor bearing bowel can be performed easily with scalpel or scissors (Fig. 3a). The handle of the clamp is removed, leaving the lock and attached string in position (Fig. 3b).

When the abdomen shows marked distention, usually in 36 to 48 hours after application of the snare, a small nick is made in the proximal loop of bowel just below the ligature. A catheter is inserted to permit the escape of gas and feces. The ligature usually falls free from the ensnared bowel in 4 to 5 days but if still adherent, it is cut and removed.

In the 5 cases in which we have used the lobectomy clamp procedure, no instance of hemorrhage, peritoneal infection, or other complication has developed because of its employment.

The Carr automatic clamp is made by Geo. P. Pilling & Son, Philadelphia.

## FIXATION OF FRACTURES OF NECK OF FEMUR BY INTRODUCTION OF KIRSCHNER WIRES<sup>1</sup>

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**M**ECHANICALLY, the articulation of the head of the femur with the acetabulum is a universal joint. Engineers seldom employ such a joint to sustain weight but rather to transmit power with almost unlimited latitude. Stress and strain are imposed upon the neck of the femur far beyond its original requirements. The anatomy of the femoral neck has not kept pace with the evolutionary progress of man in the erect position.

From a mechanical standpoint, an angulated support has not the strength of a straight shaft. When the area of angulation is composed of a substance less rigid than the remainder of the supporting shaft, its ability to support weight is again lessened.

There is a direct ratio between the degree of angulation and the strength of the supporting arm. In simpler terms, as applied to the femoral neck, the greater the obliquity of the angle formed by the neck with the shaft, the greater its ability to sustain weight. Hence, every effort should be made in the reduction of fracture of the hip to restore the normal oblique angle to the neck with the shaft.

Because of the small size of the capital fragment and its mobility, various means have been devised for its fixation to the neck. Many of these methods attain the dignity of major operative procedures attended by the hazards of postoperative shock and pneumonia, hemorrhage and infection, not to mention the even greater hazard of ensheathing the patient in a rigid plaster cast

reaching from the nipples to the heel on the affected side. The hardy patient, who may escape the immediate complications of the early operation, is often overtaken by pressure sores, in spite of the log rolling to which the terrified victim is subjected twice or oftener each day.

With the advent of antiseptic surgery more and more attempts at the actual fixation of the fragments have taken place. As early as 1894, in Chicago, Dr. Charles Davison operated upon a fracture of the neck of the femur and used an ivory peg to hold the fragments. He later used the autogenous fibular transplant with success.

Ivory screws, pegs, nails, metallic screws, square pegs in round holes, and every conceivable non-absorbable material has been tried. Two or more foreign bodies were necessary to prevent rotation of the head and this placed a large amount of hardware in the small capital fragment which was already suffering from a lack of sufficient blood supply. Non-union, necrosis, and death of the head of the femur resulted.

The three cornered single flanged-nail of Smith-Petersen immobilizes the fragments, prevents rotation of the head with the least amount of metal in the capital fragment. The Johansen modification allows for a more accurate placing of the flange by threading it over a Kirschner wire previously drilled into the bones.

Reinforcement of concrete by the incorporation of wires or steel rods in the mixture before the mass has set is now a well established principle of concrete construction.

<sup>1</sup>Read before the Chicago Surgical Society, December 13, 1935. From the Departments of Surgery, University of Illinois and Northwestern University, and Female Fracture Service, Cook County Hospital.



Fig 1

Fig 2

F i P d t e i g m f L S g e 6 s h m f a c t t h g h  
 the k f t h femur th ut rd t t of th haft and h t n i n g s e v  
 d ced by th g t tr chant be g p e t b o t a b l m  
 Fig P t e d t p c t e f p u t L S w t h t n of th Kirschn  
 l a i p l n s W v e m d f t e r 6 m t h s t h e c l l t o

It is not difficult to comprehend that slender steel wires of great tensile strength introduced through the osseous fragments might be of assistance in fixation of the parts and in strengthening the femoral neck.

It seems logical to suppose that anyone suggesting a method to fix the fractured ends of the femur neck securely with the least amount of foreign material or trauma to allow freedom of motion of surrounding joints and finally to make bed rest unnecessary will have done most in improving the mode of treatment.

On the female fracture service of the County Hospital we have numerous older patients who cannot be immobilized in plaster for any length of time. Patients with cardiac disease, diabetics with decubitus ulcers and poor peripheral circulation who are prone to pressure sores from a rigid cast, patients with large varicose ulcers, hyperten-sives and hyperthyroids, and finally weak old persons who develop postural hypostatic pneumonia belong to this group.

Gaenslen described a method of subcutaneous spike fixation of fractures of the neck of the femur which is quite complex, requires special apparatus and numerous rapidly developed roentgen ray

films. After hearing his paper before publication we independently devised a method of inserting Kirschner wires into the femoral neck fractures. It was with surprise that we read of the work of Telson and Ransohoff who have an identical technique but who were doing this work before it occurred to us.

#### TECHNIQUE

The method is as follows. The capital fragment is fixed by means of three or more Kirschner wires which are inserted into the head through the shaft fragment in various planes thus preventing any rotation of the head. We have found it possible and helpful to reduce this fracture under local anesthesia. One fourth grain of morphine and 1/100 grain of atropine are given one half hour before moving the patient from the bed. The patient's hip is cleansed and 30 cubic centimeters of 2 per cent novocain is injected into the hip joint by inserting a needle through the capsule from the lateral margin sliding along the bone. While in the joint the lateral margins of the neck fragments are easily palpated with the needle and the direction of the neck is ascertained. The angle of the neck may be marked on



Fig 3



Fig 4

Fig 3 Pre-reductive roentgenogram of A C, age 74 Fracture through the neck of the femur with upward displacement of shaft

Fig 4 Patient A C Post reductive film with insertion of three Kirschner wires 10 months since onset Wires still *in situ* No symptoms from wires Good union

the skin by insertion of a hypodermic needle. Within 20 minutes, the hip has become well anesthetized. Morphine  $\frac{1}{2}$  grain is now given and the patient becomes sufficiently narcotized to be moved onto a Hawley table without discomfort, and can be securely fastened.

The fracture is then reduced by the Ledbetter modification of Whitman's method. This consists of flexing the hip to 90 degrees and inverting the leg, followed by circumduction to abduction of the shaft, allowing the heel to rest in the palm to see if the fragments are apposed. If the leg rolls out, there is insufficient apposition. The fragments are then impacted by the Cotton method, and the leg is fixed in the Hawley table.

The leg in abduction changes the position of the neck, so that it is advisable to insert a sterile needle into the joint to determine the exact lateral margins of the neck. The wires are now drilled into the femoral head from a point on the outer surface of the femoral shaft just below the greater trochanter. The exact distance of insertion is undetermined but an estimate may be made from measurement of the normal femoral neck on the roentgen-ray film. One may determine the distance by a direct scale on the telescopic attachment of the drill. If the wires are in

too far, when removing the leg from the Hawley table there will be restricted motion in the hip and the offending wire can be withdrawn. However, we now take a roentgen-ray plate and develop it immediately. The wires are then either inserted further or withdrawn slightly. The skin around the protruding wire is pressed against the femur as closely as possible and the wires are clipped short, thus allowing the subcutaneous tissue to be pulled over the wires which can be felt deep beneath the skin. Dry dressings are applied to the puncture holes in the skin.

Patients are *not* placed in any retentive apparatus but allowed to lie in bed with a pillow beneath knee and heel. Movement is encouraged when we feel a good reduction and fixation have been made. Patients are able to raise their extremities from the bed after 10 days under ideal conditions. They may sit up in bed bend the knee and hip, and be up in a wheelchair. There is no contra-indication to the use of a caliper after 6 weeks and allowing the patient to walk about in abduction. Most of our patients were too old to walk until they had complete confidence that they could put weight on their fractured extremities.



Fig 5



Fig 6

Fig 5 J N Illype t i h rt dusee and fract re th gh femur eck t  
t ngle  
Fig 6 J N Aft d ct on ff act and n tio of three w int head a d  
fourth ly g ts d f bo Th w re w ll ed t ma n soft p ts f r s  
m th and a then m d th the thers b ause f i ritat on f ski bel  
t och nt



Fig 7



Fig 8



Fig 9

Fig 7 I set the ff i p t t M M g 7s  
d l cal the P t ntd d o w k ft rth r  
f th d th be g itrib led t a da de  
mpe sat

Fig 8 F D g 68 Inse t n f th e th gh  
eck f the f m  
Fig 9 O D F act e thr gh th mud po ti f th  
ck w th the t n of f K rsch wir



## RESULTS

We have inserted wires in 12 patients, one of whom had pernicious anemia with cord changes and had not walked for years with resultant atrophy of the bone. Closed reduction under fluoroscopy was unsuccessful as the roentgen-rays were too distorted and the wires were not placed accurately in the head, secondly, the bone was atrophic and very thin. Only one patient is less than 50 years of age, the majority are over 60. These patients were treated by this method as all other methods available, "Ambulatory Treatment" (3), Whitman cast (9), Roger Anderson (1), Jones splint (2), Wilkie boot (9), could not be used for reasons described. Our patients have been very comfortable and were up in wheelchairs early in the course of treatment. One 72 year old cardiac patient, who developed an acute heart failure with dyspnea, could be propped upright in bed and digitalized without discomfort or without the loss of position of the fragments.

The almost complete absence of any form of restraint confers upon the patient a sense of well being unapproached by any other method. There is no shock to the procedure. The specters of hemorrhage and infection have not yet made their appearance. Hypostatic pneumonia is not to be dreaded because of freedom of motion. A complication nearly always encountered in treatment by cast or traction is partial or complete ankylosis of knee or ankle. This is obviated by frequent

passive and active motion in these joints during the stay in bed.

## CONCLUSIONS

1 The use of the Kirschner wires is a definite improvement upon the older methods of treatment.

2 Closed manipulative reduction and skeletal fixation without arthrotomy approximates and fixes the fragments with the least trauma.

3 Patients are comfortable and happy in a home environment and can be easily nursed.

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# CONSERVATIVE SURGICAL TREATMENT OF CARCINOMA OF THE PENIS

## A TECHNIQUE FOR PARTIAL AMPUTATION<sup>1</sup>

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THE treatment of carcinoma of the penis has followed a definite trend toward conservative surgical therapy of recent years. J D Barney in 1907 was among the first to recognize that radical surgery was not essential in the majority of cases. Young was an early advocate of preservation of the penile stump describing his technique of radical operation. Barringer and Dean were probably the most ardent proponents of conservative methods and avoided radical surgery where possible. Others including Carlisle Wyeth and McKenna stressed the protective value of preservation of the regional lymphatics. Recently Campbell and Bowing and associates have stressed the value of less radical measures.

The factor of grading malignancy according to the classification of Broders has had some bearing on the present course of treatment. Bowing found that approximately 60 per cent of their 193 cases were of the lower grades of malignancy, the largest number occurring in grade II. Leighton's group showed the same tendency to the lower grades of malignancy. Consequently such lesions tend to grow slowly and to metastasize late. Metastasis occurred in Dean's series about 33 months after onset of the primary lesion.

The lymphatics of the penis drain by way of the deep lymphatics into the external iliac and pelvic glands as well as to the superficial groups in the inguinal region. Of one hundred cases that Barney reported 15 had metastases in the pelvis. It is not uncommon for recurrences to follow radical gland dissection where regional metastases are known to have been present. Dean had 40 patients with metastases, 32 of whom are known to have died of carcinoma. Radical gland dissection of the superficial lymphatics is therefore of dubious value. Barringer's recent report on inguinal gland metastases in carcinoma of the penis based upon study of 100 cases at Memorial Hospital further emphasizes the futility of inguinal gland dissection.

The treatment as constituted at the present is based upon the size of the lesion, the extent of the involvement and the presence of infection and metastases. We believe with Dean and with Campbell that a lesion involving less than the distal half of the penis should have simple ampu-

tation 1.5 to 2 centimeters proximal to the involved portion. This group comprises the majority of penile cancer. The cases with regional metastases should have gland dissection at a later date if deemed advisable. The most important reason for the two stage operation is to allow sufficient time for the infection in the regional glands to subside. Glands that do not regress may be checked by simple biopsy. The majority of cases show palpable inguinal nodes but since the primary lesion is most always ulcerative it is not surprising that thus adenopathy is solely due to infection in half the instances where it occurs (1-6, 9, 11, 12).

## TECHNIQUE OF LOCAL AMPUTATION

After sterile preparation of the patient the glans with the lesion is wrapped in sterile gauze to avoid contamination of the wound. A circular skin incision is made about the penis 1.5 to 2 centimeters proximal to the involvement (Fig. 1). The skin is bluntly dissected toward the base for a short distance ligating the dorsal vessels. The ventral aspect of the organ is now brought into view and the corpus spongiosum incised at the level of the original skin incision (Fig. 2). A No. 20 F catheter is inserted into the urethra to be used as a guide during the dissection of the corpus spongiosum from the corpora cavernosa. If the line of cleavage is found the procedure is relatively easy (Fig. 3) otherwise one must avoid injury to the spongy body and urethra by sharp dissection within the adjoining capsules of the corpora cavernosa. The corpora cavernosa are transected 1.5 centimeters above the level of the corpus spongiosum (Fig. 4). The cavernous arteries are ligated. Two heavy chromic mattress sutures are now placed horizontally through the entire thickness of the corpora cavernosa (Fig. 5). These sutures are hemostatic and importantly shape distal end of stump. Four vertical sutures through the corpora cavernosa capsule bring the stump to a conical shape. A suture tack the corpus spongiosum over the rounded end bringing the urethra out the mid point with 1 to 1.5 centimeters projecting beyond end of stump (Fig. 6). The skin is trimmed to fit the stump and closed on a horizontal line with interrupted silk sutures.

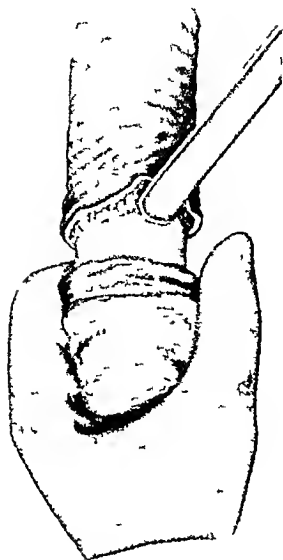


Fig 1

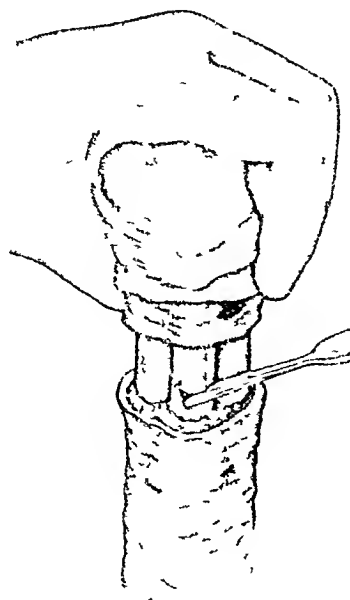


Fig 2

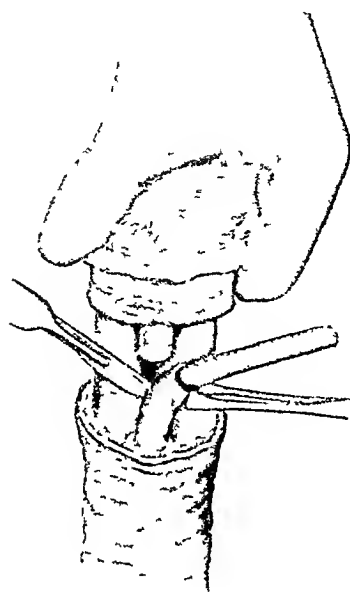


Fig 3

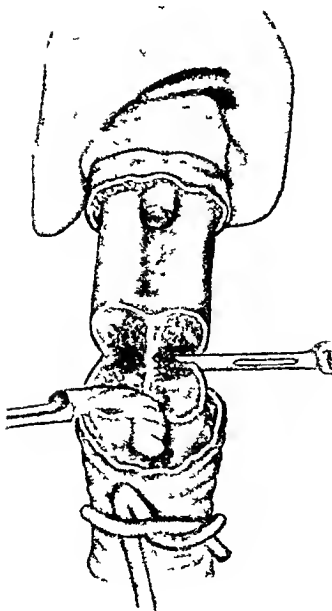


Fig 4

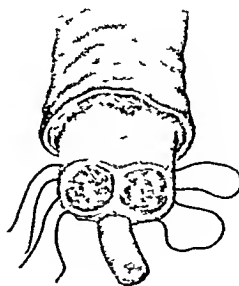


Fig 5



Fig 6

The importance of allowing the corpus spongiosum to project beyond the stump cannot be overemphasized. The retraction which always occurs very quickly provides a normally functioning meatus which projects a millimeter or two and allows the free passage of a normal urinary stream. Failure to allow for this retraction results in a most unhappy outcome from either stricture or retraction of the meatus or both.

Vaseline gauze dressings are applied and are changed daily. The catheter is left in until the skin sutures are removed.

The end results show to advantage in that the penis is well shaped and is an entirely satisfactory urinary as well as sexual organ.

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## THE TREATMENT OF FRACTURES OF THE OS CALCIS BY PIN TRACTION

### A STUDY OF END RESULTS<sup>1</sup>

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PIN traction has been generally accepted by surgeons in this country as the most satisfactory form of treatment for the troublesome squamous fracture of the os calcis. As it is now approximately 5 years since American surgeons first practiced the Boehler method studies of the results obtained by this treatment seem timely. The purpose of this paper is to present a series of 17 cases treated by pin traction with a view to (1) pointing out the satisfactory outcome that may be obtained under this form of treatment and (2) comparing the results with those obtained in series of cases in which little or no treatment had been carried out, or in which an attempt at correction had been made by manipulation or in which the modern French method of elevating the talus had been used.

Any contribution on this subject also represents another plea for adequate treatment of the fracture. In spite of ample discussions in medical literature on the seriousness of the lesion and the problem of reconstruction of the foot the fracture continues to be neglected. The surgeon is still seeing the case that received little or no treatment or in which reduction was attempted without

restoration of the anatomical relations at the subtalar joint. In view of these neglect efforts must be continued to focus attention on this fracture which may appear to be a simple lesion but which is so often followed by permanent disability.

#### SUMMARY OF CASES TREATED BY PIN TRACTION

The fractures in this series were of the average type that is comminuted or assured with impaction and disruption of the astragalocalcaneum joint.

The series includes a total number of 17 patients who were treated between the years 1914 and 1915. Four cases were bilateral but in only one of the 4 cases were fractures in both heels so serious as to require pin traction treatment.

Sixteen patients were males with an average age of 45 years. They were industrial workers and had sustained the crushing fracture of the calcaneum while at work.

In all but 1 case in which shock had been extreme treatment by the Boehler method was instituted in 1 to 4 days after the accident. In the exceptional case it was necessary to wait 21 days before attempting reduction.

**End results.** The results in 6 cases must not be considered as the patients have been treated only within the past 3 months.

<sup>1</sup>Talus is the bone of the foot. The os calcis has a process for the articulation of the talus and which together with the astragalus and the calcaneus form the heel. The os calcis is a bone of the foot.



FIG. 1. M. M. A., left. Fracture of the os calcis with comminution and displacement at the astragalocalcaneum joint. Also fracture dislocation of the calciphoid. FIG. 2. Roentgenogram taken 12 years after reduction.

The 11 remaining patients, including the 2 cases of bilateral fractures, were examined from 1½ to 4 years after treatment. The approximate periods of follow-up may be tabulated as follows:

1½ years	2
2 years	5
3 years	1
4 years	4
Total (11 patients)	12

The end results were evaluated on the basis of functional rehabilitation, that is, the fitness of the patient to return to his occupation in industry. On the group of 11 patients all but 1 obtained a good result. They walked without a limp and had no symptoms. Ankle joint motion was normal. Inversion and eversion were limited from one-third to one-half, but the restriction constituted no handicap. Eight patients had returned to their former occupations, 5 as carpenters, 1 as a painter, and 4 as heavy construction workers. The 2 other patients, both of whom were plasterers, claimed that they could work if jobs were available. Among these good results were the 2 bilateral cases.

It was impossible to estimate the period of incapacity before resuming work owing to the psychological factor that always enters into these cases that involve compensation.

Six patients complained of the foot being tired after a day's work and also experienced some stiffness in stormy weather.

The roentgenographic examination of 4 of these fractures, at the time of follow-up, showed changes at the subastragalar joint that were suggestive of arthrodosis. One patient was 65 years of age and the 3 others were in the early thirties. Whether fusion would have taken place spon-

taneously in these cases, it is impossible to say. The studies of fractures of the os calcis in this respect are inconclusive. It has been observed, however, that in severe fractures the joint is destroyed in the healing process. Arthrodosis in these cases under discussion should be attributed to the type of fracture, rather than to the method of treatment.

Illustrative examples of the good results are to be seen in Figures 1, 2, 3, and 4.

One patient obtained a poor result. This was a bilateral case, but only the fracture on the right foot had been considered sufficiently serious to warrant the use of pin traction. Three weeks after the application of the pin, infection set in which did not interfere, however, with the course of treatment. One year after reduction motion at the ankle joint was perfect, and inversion and eversion were limited only a third. The patient, however, suffered from arthritic changes, and it was considered advisable to perform a subastragalar arthrodosis.

*Comment.* The slight restriction of lateral motion following the Boehler treatment, which is due to bony obstruction or periarthritic scar tissue in the region of the subastragalar joint, causes no serious impairment of function. In fact, it is to be questioned whether perfect function can ever be obtained under any form of treatment in these complicated heel fractures that involve weight bearing joints and that present such complex anatomical relations.

#### COMPARATIVE ESTIMATION OF END-RESULTS WITH THOSE OBTAINED BY OTHER METHODS

The series of end-results herein reported, although small in number, may be considered representative of the outcome to be expected from the Boehler treatment. A comparative study of



Fig. 1. W. R. A. 1 ft. C. m. ut d f. ture and d. k. b. l. f. ture. f. h. s. c. l. e. s. t. h. l. m. t. f. h. n. t. r. e. s. i. n. 67 y. e. r. k. p. t. u. t. B. R. e. t. g. n. g. m. t. a. k. a. 3 y. e. r. s. f. t. r. d. u. t. i. o. n. h. u. n. g. b. l. i. r. a. t. i. o. n. f. t. h. e. s. u. b. s. t. a. g. a. l. r. j. i. n. t. C. l. i. n. i. c. a. l. l. y. t. h. r. e. f. t. i. s. e. c. c. l. l. e. n. t.

these results with those obtained by the following methods brought to light some interesting facts.

*Group 1 treated by manipulation and plaster of paris casts.* From 1906 to 1930 a series of 20 crushing fractures were treated by this method at the MacAusland Clinic. Twelve of these patients were traced after a number of years and examination was made. Seven of them were found to have the typical deformity and permanent disability that usually follow fractures of the os calcis. The foot was flat; there was marked thickening below the external malleolus; and as the result of the disturbance of the plane of the a. tragalocalcaneum joint a painful arthritic process had established itself.

The 5 other patients who were examined from 6 to 10 years after the fracture had feet that were

90 per cent normal. They were all working as linemen, railroad men, or farmers.

To summarize, in this group of 12 cases 7 poor results were obtained. In contrast, in the series of 13 cases in which treatment was by the Boehler method only 1 poor outcome was obtained.

*Group in which little or no treatment was carried out.* A series of 61 cases of long standing, that had received no treatment or only balm and massage or that had been treated by manipulative reduction, has been seen at the MacAusland Clinic during a period of 10 years. There was not a single patient in this group who did not complain of symptoms of pain, swelling, and restricted lateral motion of the foot. The deformity was again typical, the foot being flat and the os calcis shortened and broadened. Arthritis of the a.



Fig. 3. H. H. A. 1 ft. C. m. ut d f. a. t. of the l. is B. k. t. g. g. m. t. a. k. 3 y. e. r. s. f. t. r. d. u. t. i. o. n. h. u. n. g. b. l. i. r. a. t. i. o. n. f. t. h. e. s. u. b. s. t. a. g. a. l. r. j. i. n. t. C. l. i. n. i. c. a. l. l. y. t. h. r. e. f. t. i. s. e. c. c. l. l. e. n. t.



Fig 4 A D A, left, Fracture of the os calcis with involvement of the joint surfaces B, Roentgenogram taken 1½ years after reduction, showing bone proliferation and obliteration of the posterior subastragalar joint Excellent clinical result

tragaral joints was a common finding No patient had returned to his former occupation, although several were doing a light form of work.

*Group 3 treated by the modern operative method of elevating the thalamus* This method is advocated particularly in France The technique consists of restoring the thalamus to its normal articular position and fixing it by means of a metallic osteosynthetic material or osteoperiosteal grafts (Lenormant, 3, Wilmoth, 5) Lenormant has reported 17 cases treated by this method Thirteen good results, 3 mediocre, and 1 poor result were obtained A good result is considered by Lenormant as one that came to subastragalar arthrodesis which, however, because it took place with the articular surfaces in normal position owing to the elevation of the thalamus, did not handicap the patient In the 9 industrial cases, Lenormant estimated the permanent partial incapacity as 15 per cent in 2 cases, 20 to 25 per cent in 5 cases, and over 25 per cent in 2 cases

The results considered as satisfactory under this form of treatment are those in which the lateral motion of the foot has been sacrificed In contrast, the Boehler treatment that does not entail the loss of motion in the subastragalar joint, and that does not necessitate opening the fracture, would seem a far more satisfactory procedure Should a painful subastragalar joint result from the Boehler treatment, an arthrodesis can be satisfactorily carried out at that time

#### FEATURES OF THE BOEHLER TREATMENT (FIG 5)

The Boehler pin traction method meets perfectly the problem of treatment in the case of the crushing fracture of the os calcis Its provision for the restoration of the posterior fragment, which is always displaced upward in these cases, guards against a painful weight bearing surface on the bottom of the heel By this method, normal anatomical relations at the astragalocalcaneum joint, and if necessary at the calcaneocuboid joint, are established, the os calcis is restored to its normal width, and the plantar arch is raised

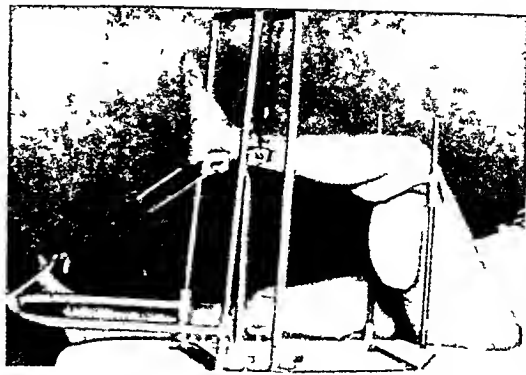


Fig 5 Boehler screw traction apparatus (Courtesy of Dr Boehler)

The technique of the method is so well known that a complete description is unnecessary. Care must be taken in breaking up the impaction to secure free motion through the normal range in the subastragalar and midtarsal joints especially in inversion as such motion tends to iron down the edges of the fragments that project into the joint space and to smooth the articular surfaces. It is these edges and spicules projecting into the joint that cause pain on walking on uneven surfaces. Another feature of the method that should be stressed is the protection of the foot by some form of apparatus for at least 6 months after the removal of the plaster of paris cast.

Some surgeons are opposed to driving a pin through a fractured os calcis but there is no risk involved when the pin is placed through the long posterior arm of the bone and at the right angle to the fragment. The comminution in fact is usually anterior to the site of the insertion of the pin. In the case of extensive comminution in which it seems inadvisable to drive the pin through the os calcis it may be placed above the bone and anterior to the Achilles tendon with the traction weight of course in the latter site.

There is little danger of postoperative infection from the pins. In the series reported there was one case of slight sepsis but it did not complicate the course of treatment.

## CONCLUSIONS

The crushing type of fracture of the os calcis in which the plane of the large astragalocalcaneum joint is disturbed may be satisfactorily reduced by the pin traction method. It has been used in a sufficient number of cases to prove its effectiveness.

In a series of 13 fractures treated by the Boehler method 12 good results were obtained. The resulting function except for a slight limitation of inversion and eversion was perfect. The restriction of lateral motion in itself constituted no handicap and the patients were able to resume their former occupations as carpenters, builders and painters.

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## TREATMENT OF TRICHOMONAS VAGINALIS AND TRICHOMONAS IN THE MALE

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MANY drugs and many types of treatments have been recommended for the cure of disorders caused by the trichomonas. We hesitate, therefore, to bring forward another. With the co-operation of the manufacturer we have been using a drug known as devegan, in the female. Each tablet contains parovyl (3-acetyl amino-4-hydroxyl-phenyl arsonic acid), 0.25 gram, carbohydrates hydrolyzed by a special process, 0.7 gram, and boric acid, 0.03 gram. In private practice we used nothing in the treatment of the female for this disorder but these tablets.

The technique is as follows: After the hanging drop confirms the diagnosis, the vagina is cleansed with cotton pledgets. Three tablets are placed around the cervix and the speculum is removed. The patient reports three times a week, to and through the following menstrual period. Thereafter, the patient is given a supply of the tablets with instructions to insert one tablet nightly, high up into the vault of the vagina as far as she can reach. The patient returns to the office the first day of each menstrual period and every other day through the period, for four menstrual cycles, at which time the vagina is cleansed and three tablets are inserted. After the fourth period no medication is used, and the patient is requested to return at the end of a week at which time a smear is taken and if it is negative, she returns after the next period, having had no treatment. If none is found at this time she is pronounced cured.

Firm instructions are given that the husband be examined by a competent urologist to be certain that he is not a trichomonas carrier. The husband is then instructed not to have sexual intercourse without the use of condoms until his wife is pronounced cured. Natural intercourse is permitted after the fifth menstrual period if the vaginal smears are free from the trichomonas.

The patient is requested to return for an examination a week or 10 days after this sexual intercourse. If she is found to be positive, it is considered that she has been infected by her husband. The husband is then subjected to further examination by his urologist.

Up to the present we have treated 25 women. Of these, 7 have been pronounced cured, 5 discontinued treatment, and the results are not definitely known. Seven were pregnant at the time

treatment was begun and 6 are still under treatment. Of the 7 who were pronounced cured, 1 had intercourse without the use of a condom. In this instance the wife was reinfecting with the trichomonas. The husband had been under treatment and pronounced cured. This shows the importance of examining the woman's partner. We feel certain that many recurrences are due to the infection in the male. The males do not necessarily have any symptoms of urethritis, in fact, most of the males seen with the infection have no complaints.

In the pregnant patients we have not been able to do more than control the amount of discharge with the use of devegan. Our experience with this drug is similar to that of other drugs in pregnancy. It seems to make no difference whether the treatment is started early or late, the patient has marked recurrence as soon as the treatment is discontinued.

This report is made because the treatment is much simplified over the "Kleegman" treatment or the soap and water scrubbing or irrigations. The results in the control of the discharge are prompt. The treatment can be given with very little discomfort to the patient. We are not prepared to state that it will cure disorders caused by the trichomonas vaginalis more promptly than any other of the recognized treatments. If we find that it does so, we shall make further report.

During the past 7 years 30 cases of male trichomonas infections have been observed in clinical and private practice of one of us. Twenty-five men were married and 5 were single. A sufficient number have been seen to allow a comment on their etiology. It is our impression that the trichomonas infection in the male is acquired solely through sexual contact.

CASE 1: L P, male, aged 27, single, was referred to the office by Dr. C. C. Doherty on November 29, 1932. The patient's only complaint was a urethral discharge of 3 days' duration. He admitted two sexual exposures from different sources during the week preceding the onset of urethral discharge. Examination of the external meatus revealed a mucopurulent discharge which, microscopically and without staining, contained many motile trichomonads and pus cells. A stained smear showed no intracellular or extracellular diplococci. The urine was hazy and the first glass contained shreds. Rectal examination of the prostate revealed no abnormal changes except tenderness on massage. The prostatic fluid was teeming with trichomonads and 20 to 30 pus cells per high power

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While it was impossible to have the woman examined from the history it seemed probable that this man's urethra and prostate were susceptible to the trichomonas after sexual contact. He stated his consort was free from genital or urinary symptoms. That patients male or female may harbor the trichomonas in the genital tract without symptoms is an established clinical fact.

CASE 2 H M mal ag d 34 mar d s xamu ed the fice n Jly 7 93 f a slight coc l On ut ne am at on tr hom nad sw fou d in th urine nd pr stat cfi d t geth r i th a f w p cll ll dmt t d n n a j sympt m He tat d that he wif h d l cor h a f t sev l y ars He tu ed to the fice gain in 913 Af vt ch m n des e e again pr nt n th prostat cat pp ps H s w f h d b n mued l b e h e nd the t ch m s v g nalis w s f u d Be ca se th y de ed a noyng ympt m ne the e could be n inced that t eatm t s ver n cessary Sterility b w se m d apparent after 6 yea s of m edile

CASE 3 J A male ag d 46 m ried r fered by Dr L Corn ll n April 24 93 b use th wfe had a ec r nt t ch m as g i s fect n The p u t h d n ary e mpla nts exc pt noct na Famin Gon re led th trichomonas in th p o stic flu d and urin t g the with f w p u clls Af u pl sug r in th n e w also n ted N nu ual p o lat and n g w ep se t e c pt lght e larg me t He was t e t d f r 6 week E am n t ion J e s how d th p tate d n n t b f e from th tr i h m n s. H has n t r tu ed f r e c nt h ck p

It seems that in Case 2 there was a latent marital infection without symptoms at least not severe enough to seek medical relief or treatments. In Case 3 the husband had very little evidence of prostatic infection but a sufficient number of the trichomonas were present in the

seminal fluid to allow contamination of the wife's vagina through sexual intercourse.

While admitting that trichomonas infection in the male apparently is not nearly as common as in the female there are probably many more cases than are reported or found at the present time. Many urologists do not examine fresh prostatic secretions. Many general practitioners never use a microscope in treating urethral or prostatic infections. Stained preparations will not identify the protozoan. Examination of fresh urethral and prostatic secretions should be followed more closely by physicians who are examining and treating male patients. Many cases of so called non specific infections in the male have always been noted. Some of these are complicated by the presence of the trichomonas.

Regarding symptoms as stated before there may be none. Usually symptoms of chronic prostatitis are present. A urethral discharge is present when the urethra is involved. Examination of fresh urethral and prostatic secretions or urinary sediment with the microscope will reveal the motile trichomonas.

In general the same principles of treatment have been used as in other non specific infections of the lower urinary tract in males. Prostatic massages urethral and deep instillations have caused a disappearance of the trichomonas in all cases which were adequately treated and followed up. Five cases of trichomonas prostatovesiculitis were complicated with multiple strictures of the anterior urethra. The damaged urethra may be a factor in paving the way for trichomonas infections. These 5 cases occurred in the married group. Three of the wives which have been examined harbored the trichomonas in the vagina. When urethral strictures are found they should be eradicated if possible. Weak neutral acriflavine solution (1:2000) has been the most useful drug in clearing up the urethral infections.

## FURTHER OBSERVATIONS ON THE TREATMENT OF FRACTURE DISLOCATIONS OF THE CERVICAL SPINE WITH SKELETAL TRACTION

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**I**N 1933 a case was reported (1) in which extension tongs had been applied to the skull for the purpose of exerting traction upon the cervical spine. This patient presented a complete, forward dislocation of the second cervical vertebra with overriding of the vertebral bodies. Due to the extreme dislocation and precarious position of the uninjured spinal cord, careful traction was considered the treatment of choice. Traction against the chin was impossible, since among other injuries there was a compound, comminuted fracture of the mandible. At the suggestion of Dr C C Coleman the desired traction was made possible through the application of tongs to the skull. Although a complete reduction was not obtained in this case, the results were highly satisfactory and indicated the value of the method as a routine procedure for the treatment of certain fracture dislocations of the cervical spine.

McKenzie, in a recent publication gives his experience with skeletal traction in the treatment of cervical dislocations. The results in his hands are similar to those obtained in this clinic.

Since the original report the technique of applying skeletal traction has been improved and simplified by the adoption of specially designed skull tongs and drill points. This and additional experience with the method are believed worthy of further comment.

The general principles involved in the management of spinal cord injuries have been dealt with extensively in the literature. The primary object of any method of treatment is to relieve spinal cord compression. This must be accomplished as quickly as possible with a minimum risk of endangering life and of increasing the spinal cord disability. Spinal cord compression is usually relieved by reduction of the dislocation. Epidural and intramedullary hemorrhage as well as indriven fragments of bone may give rise to spinal cord compression, even after reduction of the dislocation has been accomplished. Such complications, however, are not common and cannot with any degree of satisfaction be diagnosed if

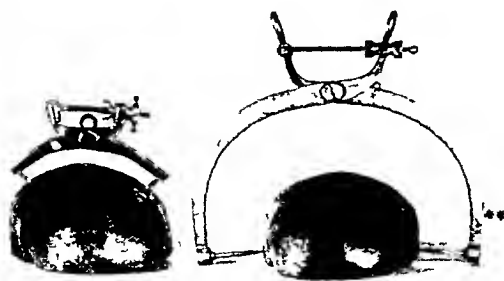


Fig 1 A, left, Skull tongs in position. The points enter the skull at almost a right angle. B, right, Femur tongs such as these may be used but due to their large size they prevent rotation of the patient from the recumbent position.

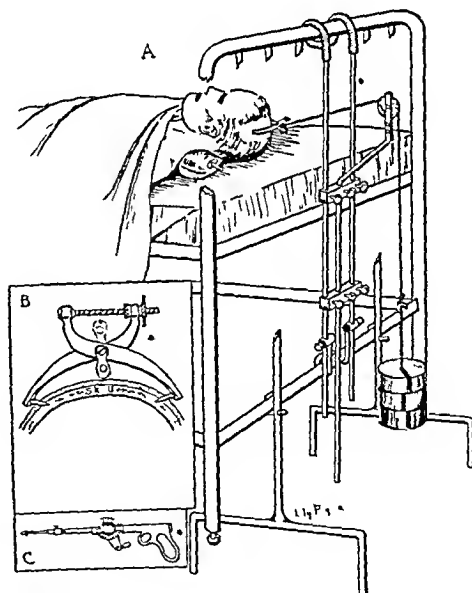


Fig 2 A, Traction apparatus. The tongs are applied in a vertical plane passing through the articulations of the cervical spine. A pneumatic bag such as illustrated (made from section of a small inner tube) affords a comfortable means of applying counter pressure. B, The traction bar serves as a guide for placement of stab wounds at equal distances from the midline of the skull. C, Drill with fixed guard 3 millimeters from the point to prevent excessive penetration.



Fig 3 Case 4. Left. Photograph of patient in bed. Right. Photograph of patient in bed. The patient is lying on their back, and their head is being supported by a device. The photographs show the patient from different angles, including a side view and a front view.



Fig 4 Case 4. Left. Photograph of patient's head in flexed position. Right. Photograph of patient's head in extended position. The patient is lying on their back, and their head is being supported by a device.



Fig 5 Case 4. Left. Photograph of patient's head in flexed position. Right. Photograph of patient's head in extended position. The patient is lying on their back, and their head is being supported by a device.

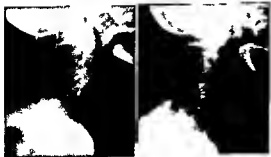


Fig 6 Case 3. Left. Photograph of patient's head in flexed position. Right. Photograph of patient's head in extended position. The patient is lying on their back, and their head is being supported by a device.

accompanied by a dislocation until after reduction of the latter has been accomplished.

Severe fracture dislocations of the cervical spine may occur without evidence of spinal cord injury. Reduction of the dislocation is highly desirable to aid in the prevention of nerve root pain and to secure a more mobile spine. It is needless to suggest that reduction in such cases incurs a responsibility and therefore the method of treatment adopted should offer the least possible danger of injury to the spinal cord and nerve roots.

Tongs applied to the skull affords an efficient means of exerting a continuous pull on the cervical spine. Traction applied in this manner offers certain advantages which are believed worthy of consideration. It is more efficient than skin

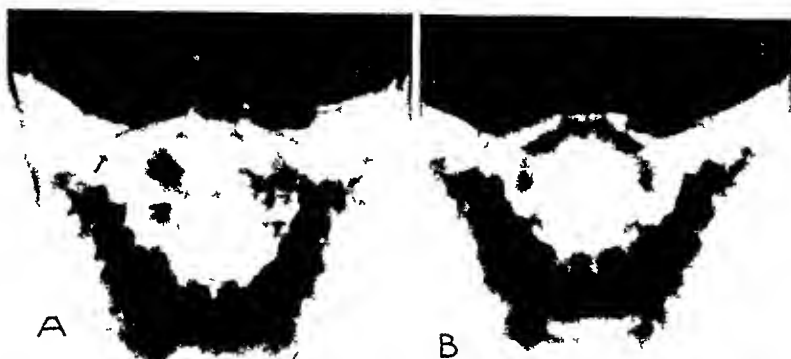


Fig 7 Case 4 A, left, Rotary dislocation of the atlas B, right, Complete reduction was demonstrated within approximately 5 hours after the application of 5 pounds of skeletal traction

traction and is free from the dangers which have been associated with manual reduction. The force of skeletal traction can be controlled and its application is relatively painless. Continuous and prolonged traction against the chin and occiput is, in our experience, less efficient, more uncomfortable, and is often accompanied by pressure necrosis of the skin. Its effect is partially offset by spasm of the neck muscles which it produces. Frequent adjustments of the sling are necessary for proper fitting and to secure traction in a desired direction. When traction is applied to the skull, these disadvantages are not encountered.

Results have demonstrated that the efficiency of the pull by this method will quickly bring about a reduction of certain high dislocations. Since the time element in such cases compares favorably with that of open operation, it would seem that skeletal traction should, in most cases, lessen the necessity for laminectomy to relieve spinal cord compression.

Dislocations below the fifth cervical vertebra are more difficult of reduction by traction alone. The effect of traction upon the lower cervical spine, however, can be demonstrated by a widening of the intervertebral spaces when the pull is increased upward of 10 pounds. This suggests the possibility of obtaining satisfactory results by exerting counter-pressure against the spines of the posteriorly displaced vertebrae after traction has brought about an unlocking of the intervertebral articulations or correction of the overriding of the vertebral bodies. More experience will be necessary to determine the possibilities of skeletal traction in the treatment of low dislocations, but inasmuch as the method is relatively

painless and a continuous, forcible pull can be easily tolerated, it is believed justifiable to assume that it will be of value in the treatment of all fracture dislocations of the cervical spine.

While we regard skeletal traction as the most efficient method of dealing with the large majority of fracture dislocations of the upper cervical region, laminectomy or manual reduction as advocated by Alfred Taylor may sometimes be required.

#### APPLICATION OF SKELETAL TRACTION

Tongs should not be applied to an extremely thin or diseased skull and they should not be applied through infected scalp tissue.



Fig 8 Case 5 Chronic osteomyelitis of the cervical spine. Lead pellets attached to the back of the neck by means of adhesive tape are shown in this film. They serve to establish landmarks for the correct placement of counter-pressure. Skeletal traction was of little value in this case because of the ankylosis that had already developed.



Fig. 9. A. Lateral dislocation of the sixth cervical vertebra. B. Four days after application of 12 pounds of lateral traction. C. Complete reduction of the dislocation five days after application of traction.

Femur extension tongs were first used and applied to the temporal bones just above the ears. Due to their width these tongs were not entirely satisfactory in that they did not permit the patient to be turned from the recumbent position. This serious handicap, especially in the management of paralyzed patients, was overcome by using small specially designed tongs that clamp into the vertex of the skull (Fig. 1<sup>1</sup>). A description of this method will be given.

The tongs are applied transversely to the vertex of the skull in a vertical plane passing through the articulations of the cervical spine (Figs. 2A and B). The mastoid tips are approximately within this plane and serve as satisfactory landmarks.

The tongs are designed so the traction bar can be used as a guide for correct placement of the tong points (Fig. 2B). The traction bar is turned down and placed against the scalp with the arrow pointing to the midline of the skull. The tong points are then lowered to the scalp and the points of contact are marked with a dye to indicate the level of the proposed stab wounds.

The scalp is injected with novocain and stab wounds large enough to admit the tong points are made down to the skull. Perforations of the outer table of the skull are prepared by using a small drill point about 2 millimeters in diameter

which is forced to a depth of approximately 3 millimeters. A special drill point with a fixed guard 3 millimeters from the point has been employed to prevent excessive penetration (Fig. 2C). In the average adult skull this technique should not give rise to penetration deeper than the diploe. Greater penetration is usually unnecessary. After the openings have been prepared the tong points are fitted into the bone perforations and made secure by adjusting the thumb screws. When the tongs are properly locked the points will not bore in. Drawings are applied and should be changed frequently.

The head of the bed is elevated about 12 inches and traction is applied. Amounts varying from 9 to 15 pounds are usually sufficient (Fig. 2A). We have not applied more than 18 pounds. The direction of pull and other mechanical details are essentially the same as those applicable to other methods of traction and must be planned according to individual requirements. Due to the increased efficiency of this method of continuous traction, early roentgen examination may show complete reduction of high dislocations within a few hours.

Although skeletal traction can be safely maintained over a period of weeks, it should be discontinued and a plaster collar applied as soon as reduction has been accomplished or after its maximum effect has been obtained, which should be



## FRACTURES OF THE CONDYLES OF THE TIBIA

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WITH the increased density of automobile traffic on our city streets and ever increasing number of street accidents fractures about the knee have assumed an importance and frequency not accorded them in the literature or in textbooks on the treatment of fractures. In the precarious plight of the city pedestrian the knee seems to be the most vulnerable point. A true hinge joint at the exact level of the automobile bumper, and most frequently struck on its weak lateral side, torn lateral ligaments, fracture-sprains or fracture of one or both condyles result. Cotton emphasized the importance of these fractures in 1930 and gave the most common type depressed fracture of the lateral condyle its name of fender fracture. The automobile in contact with the jay walking citizen has brought a previously rather rare fracture to the fore.

The first description of a fracture of the condyles of the tibia was by Thamhain (6) in 1852 and from that time until 1930 only 263 cases were reported in the literature. Since that time numerous series have been reported, the largest being that of 125 cases by Cubbins and associates from the Cook County Hospital. In spite of the large number of reports there is still the greatest confusion as to the methods of treatment and as to prognosis. This prompted us to review the cases seen on the First Surgical Service at Bellevue. During the past 10 years we have treated 58 cases of which 15 were of the medial condyle and 43 of the lateral. Ten cases were inadequately followed. The 48 remaining have been followed from 1 to 5 years long enough to determine the final result.

Fractures of the condyles of the tibia are of a multitude of forms, in fact no two are exactly alike. However they may be grouped as follows in essentially the same classification used by Bechter and by Cubbins.

1. Fracture of the medial condyle (a) Sprain fracture in which the medial lateral ligament tears from the medial condyle carrying small fragments of bone with it (b) vertical splits with widening (c) compression fractures.

2. Fractures of the lateral condyle (a) With depression of the anterior lip (b) With depression of the posterior lip (c) With depression of the entire condyle.

3. Fracture of both condyles—this usually is in form of inverted V or Y.

The last three groups are usually combined with fracture of the neck of the fibula.

## ETIOLOGY

In close agreement with other reported series 59 per cent of our cases were pedestrians struck by automobile bumpers. Sixty eight per cent of Swett's series were of like etiology. The etiology of the remaining cases were too diverse to enumerate. Any blow on the knee or fall from a height forcing the knee into abduction or adduction is sufficient. In practically all cases the damage to the tibia is caused by one or the other condyle of the femur being forced against the corresponding condyle of the tibia and either crushing it or splitting it from the shaft. In one case of a woman with great rarefaction of the bones due to old age the weight of the body in walking without any trauma or fall was sufficient to crush the lateral condyle of the tibia. This is a true pathological fracture which I have not seen described elsewhere.

## DIAGNOSIS

Every injury to the knee calls for a careful painstaking physical examination. This is extremely important because of the numerous types of injury that occur. Many injuries will be overlooked and none will be adequately understood if the diagnosis is left entirely to the roentgenologist. The history and clinical signs should enable one to make the diagnosis and get a fairly accurate picture of the damaged structures. There is a history of being struck on the knee or of a fall with the knee twisting under the body in abduction or adduction. There is fairly well localized tenderness over the inner or outer surfaces of the upper extremity of the tibia. In all but 5 of our cases there was an appreciable increase in the joint fluid and one strongly suspects that if the examination is careful enough the joint fluid will be found to be increased in all cases. The fluid may be serosanguineous or almost pure blood. In all those cases we aspirated it was frankly bloody. In 6 cases there was a note made that lateral mobility was increased. Here again the percentage varies with the carefulness of the test for in practically all cases there is increased mobility. One reason that it is frequently overlooked is that if the damage is chiefly to the posterior part of the articular surface of the con-





Fig 1



Fig 2



Fig 1 Woman, 47 years of age, with fracture of lateral condyle with little displacement, but with a stiff, painful knee after 1 year due to traumatic arthritis

Fig 2 Man, 34 years of age, with great damage to lateral condyle and poor reduction, but with perfectly good end result

dyle, increased lateral mobility is present only with the knee partly flexed. Crepitus is not present, or rather should never be elicited. Before the general use of roentgen-rays the diagnosis of these fractures was rarely made, emphasizing the importance of never omitting this examination. The maxim to roentgenograph all sprains applies with more force to the knee than to any other joint. It is surprising how frequently these fractures are diagnosed as sprains or torn ligaments, not only by ambulance surgeons and general practitioners, but by experienced surgeons as well. It is not uncommon to have patients with a fractured condyle with little depression walk into the hospital 2 or 3 days after the accident. The roentgen-ray examination is not adequate unless either stereographs or both oblique views are studied. Unless this is done, fractures of the anterior or posterior lip of the condyles are easily overlooked. Nor is it sufficient to make a diagnosis of fracture of one or the other condyle. The exact position of the fragments must be determined before any intelligent effort can be made to replace them, and this is possible only by study of stereoscopic or anteroposterior, lateral, and two oblique films.

#### PROGNOSIS

There is great diversity of opinion as to the prognosis in these cases. Until a few years ago

it was considered very grave as regards return of function. With increasing frequency and familiarity of the injury the outlook has been found to be much more hopeful. Thus in 1928 Kellogg Speed paints a truly terrifying picture: "If the knee-joint is involved, the prognosis is always grave. Final result may be a complete ankylosis."

The long relaxation of ligaments from effusion and immobilization leads to a weakened joint in those cases not stiffened by trauma. Key and Conwell say "the prognosis is poor as regards normal function." Wilson and Cochrane in 1925 say that arthrodesis may be necessary. On the other hand Cotton treated 15 cases with no valgus or instability. Swett and McPherson treated 50 cases with uniformly good results. F. Bechter had no bad results in 75 cases.

In our series the results of conservative treatment have been satisfactory. In only 4 cases has there been instability or increased lateral mobility which persisted for more than 1 year and in 2 of these it caused no disability whatever and 2 had only a slight feeling of insecurity. There has been valgus deformity in only a few cases. The chief threat is a traumatic arthritis. This is a feature in all cases and in the aged and in arthritics it causes permanent limitation of motion and persistent pain. For this reason the age and condition of the patient have almost as much to do



Fig. 3. Nutcracker used in reducing difficult cases.

with the prognosis as does successful reduction. Figure 1 illustrates this point strikingly: a 47 year old woman with little displacement immobilized 7 weeks then given intensive physiotherapy. At the end of 6 months she had only 15 degrees flexion at the knee great discomfort and would bear little weight on the knee. On the other hand contrast Figure 2: a 34 year old man with great displacement and damage to the joint poor reduction treated the same way except that he was immobilized for 10 weeks. Yet at the end of 4 months he was back at work with full range of motion and no pain.

#### TREATMENT

The treatment of these cases in spite of their great frequency has not become established on a secure basis. Open reduction and fixation, bone grafting, closed reduction by manipulation and by various devices and traction each has its ardent advocates. Key and Conwell say that in depressed fractures there is no choice—all should be treated by traction. Cubbins advocates open operation and fixation with bone grafts in most cases. Bechter, Cochrane and others advocate open operation and fixation by screw or bolt

unless almost exact reduction is obtained by closed methods. Boehler raises the depressed fragment with a steel pin through a puncture wound. All agree that if reduction can be obtained by closed methods it should be done.

All patients should be given an anesthetic. We prefer spinal giving 50 milligrams of novocain in 1 cubic centimeter of spinal fluid and having the patient lie on the affected side for 10 minutes after the injection so that anesthesia is limited to little more than one lower limb. In depressed fractures of the lateral condyle the capsule and external ligament are intact and attached to the depressed fragment hence traction and forced varus position very effectually use this ligament to bring the fragment into place. If only the anterior lip of the condyle is depressed the knee should be forcibly flexed as this exerts tension on the anterior part of the capsule. The use of the mallet to hammer the fragment upward has not been effective in our hands. A very simple and effective instrument is illustrated (Fig. 3) which we have used to reduce some of the more difficult cases. The knee is placed in the nutcracker device and tremendous pressure can be brought to bear on the displaced fragment either upward or directly toward the shaft. In depressed fractures one arm of the instrument is placed on the depressed fragment and the other above the opposite condyle of the femur. The knee should be rotated slightly and pressure applied in several positions.

It must be remembered that the pressure brought to bear on the soft parts and bone with this device may be tremendous. With upright pieces 5 feet long one hundred pounds pressure applied at the upper end will give a pressure of one thousand pounds on the limb. The upright pieces are turned edge wise so that this pressure is applied over a surface of about 2 square inches. In view of this the leg must be adequately protected by thick saddle felt padding and extreme care used not to place the upright on the neck of the fibula where the peroneal nerve lies on the lateral surface of the bone. The sensation on the dorsal surface of the foot and the ability to extend the foot and great toe should be tested before and after applying pressure on the lateral surface of the knee to guard against damage to this nerve. Any piece of timber about 1 by 3 inches and 5 feet in length may be lashed together at one end to make the device. Cross pieces from the ordinary Balkan frame are convenient and suitable. We have used this device with some success in reducing fractures of the os calcis with widening and mushrooming of the bone.

After reduction the leg is placed in circular plaster casing from the upper part of the thigh to the toes with the leg in the proper weight bearing axis. It is better to overcorrect the deformity slightly, and to put the leg in varus position as a bow-leg is much more stable and useful than a knock-kneed one. We have kept the leg immobilized in circular plaster casing for 6 to 10 weeks. After this removable splints or a walking brace is applied and active and passive motion started. No unprotected weight bearing is permitted for 12 weeks. While in the casing the patients are encouraged to exercise as best they can by contracting the thigh and leg muscles. This reduces the amount of atrophy and period of convalescence after the casing is removed.

We believe that very early active and passive motion is harmful. The joint surface is damaged and there is always damage to the collateral ligaments. Healing proceeds most rapidly and is most complete under conditions of absolute rest. Boehler and Swett and McPherson also maintain that early motion is actually harmful. In a few of our earlier cases early motion was started but had to be stopped because of increased and painful effusion into the joint—an evidence that the treatment was damaging the articular surface.

Others more fortunately situated have been able to shorten the period of disability by starting active and passive motion in suspension with balanced traction. Since our patients must be ambulatory after a short hospital stay and are not very closely supervised, we have been forced to adopt the longer period of immobilization.

In those cases in which depression persists we still do not operate because in common with all observers we have seen cases in which depression has been allowed to persist and a useful and painless knee result. Figure 2 is our most striking case of this kind. Again, we must emphasize that the disability and poor results obtained are due to arthritis and damage to the joint surface, which operation does little to help, and not to anatomical displacement. These fractures must be thought of as living tissue that has been crushed and deranged and not as blocks of cement that have been chipped off.

We have done open reduction with fixation by bolt four times in cases with widening and depression. Figure 4 illustrates one of these cases. While this man eventually got a 4-4-4 result he had limitation of motion for 15 months. This also illustrates the fact that even at open operation exact anatomical restitution is not feasible or necessary. The average hospital stay for the operated upon patients was 51 days, for the non-



Fig. 4. Open reduction and fixation by bolt. A type of operation which should be abandoned.

operated upon 27 days. The average occupational disability for the non-operated upon cases was 12 weeks while for the operated upon cases it was 21 weeks. One of the operated upon patients had pain and stiffness after 2 years. In reviewing these cases we would not at the present time operate on any of the four. We agree with Cotton who says, "Attractive as open operation is, it is not the answer in these cases. I shall do no more if I can help it."

The treatment of fractures of the medial condyle is similar to that of the lateral. The more common sprain fracture or tear in the internal collateral ligament never requires suture. These ligaments are short, inelastic, and do not retract any distance so that, if the knee is put up in forced varus, the torn ends are brought close together and with the contracture of the granulation tissue that fills the gap a perfectly stable knee results. As MacGuire pointed out, even by open operation suture of the torn shredded ligaments is not satisfactory and accomplishes nothing except to expose the patient to the danger of infection. In these 58 cases, all of which had more or less damage to the collateral ligaments and some as much as 20 degrees lateral mobility, only 2 had any disability due to an unstable knee and in these it was not of any consequence. Other observers who give adequate periods of immobil-



Fig 5

Fig 6

Fig 7

Fig 8

Fig 5 Fracture of both condyles with widening and depression

Fig 6 After reduction has been accomplished with nutcracker device

Fig 7 Wedge action of upper end of shaft for girding the parts despite skin tightening

Fig 8 Same case after 7 weeks reduction maintained by skin traction

ization report that instability never occurs so why suture the ligaments and incur the risk of sepsis however slight?

All these fractures have a hemarthrosis or effusion into the knee joint. If the capsule is at all distended the fluid should be aspirated before reduction is attempted. It may reaccumulate and require aspiration after reduction.

In fractures of both condyles the upper extremity of the shaft is wedge shaped and pulled upward by the powerful thigh muscles. It separates the condyles no matter what type of immobilization is used except of course internal fixation. Figures 5, 6 and 7 show such a case in which circular plaster casing applied directly to the skin failed to maintain the reduction. In all these cases traction must be used in treatment. Skin traction properly applied is adequate but a pin through the os calcis may be used. Figure 8 shows the end result in the same case after reduction was obtained by the nutcracker device and maintained by traction.

#### SUMMARY

- 1 The frequency and importance of so called bumper fractures is emphasized.
- 2 Fifty eight cases with final results of 48 are reported.

3 Non-operative treatment is strongly advocated and our method is described.

4 A simple and universally available device for reduction is presented.

5 Fractures of both condyles must be treated by traction.

6 Operation for torn lateral ligaments is not justified.

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## LARGE BOWEL OBSTRUCTION

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**A**CUTE obstruction of the large intestine is a fairly common condition. Carcinoma of the large intestine is a fairly common disease and is the common cause of the acute obstruction. There are only three other causes and these are volvulus of the cecum or sigmoid, diverticulitis of the sigmoid, and congenital or operative adhesions. There is one other disease which produces symptoms which may closely resemble those of large bowel obstruction and that disease is stone in the kidney. These statements sum up the etiology of large bowel obstruction.

During the last decade a very noticeable advance has been made in the management and treatment of both small and large bowel obstruction. As has always been the case in medicine or surgery when any great advance has been made, it was the appalling death rate which brought the impetus for improvement. In the case of small bowel obstruction the road lay by way of physiology and biochemistry; in the case of the large intestine by the realization that the patient was sick from his obstruction and not from his carcinoma.

The disease, carcinoma, occurs in all sections of the colon from the cecum to the sigmoid. Its frequency is greatest in the sigmoid section, from 25 to 30 per cent of the cases of carcinoma of the colon being located there. The balance is about equally distributed between the ascending colon, the transverse colon, the splenic flexure, and the descending colon. The disease exists in two forms: first, the napkin ring or constricting, and second, the pedunculated fungating variety. It is the former, the constricting type, that is the cause of the obstruction.

Rarely does the disease cause obstruction in the bowel proximal to the hepatic flexure because of the fluidity of the bowel contents. Hence there are two clinical types of patients who present themselves suffering from the disease: first, those with the disease in the bowel proximal to the mid transverse colon; second, those whose disease lies distal to that point. The patients of the first group suffer from diarrhea, anemia, and cachexia, and indeed any patient past middle life presenting himself with this group of symptoms is very likely to be suffering from carcinoma of the stomach or carcinoma of the cecum or ascending colon. Those of the second group are the patients who come into hospital with acute obstruction and have a

lesion in the transverse colon or distal to this point. Apparently we have not yet reached that Utopia in our social state where an individual, be he a city or a rural dweller, considers it advisable to consult a doctor over "difficulty with his bowels" before he has given the various laxatives a trial. The sad part is that his efforts may meet with a degree of success for some months and he is quite content to put up with a state of semi-obstruction. If he should report to his doctor the symptoms which should make the doctor suspicious are increasing constipation, griping pain with or without laxative, blood or mucus in the stools, and increase in girth. These symptoms should lead to a very careful history analysis, a sigmoidoscopic examination, and a barium enema and never a gastric series until the barium enema plates have been carefully studied.

However, the fact remains that we have not yet reached a point where more than 15 per cent of the patients come to us before the advent of obstruction. In this there is little, if any, change over a period covering the last 15 years. There is, however, a change in the management and treatment, and a very marked change, and consequently a minimum mortality rate. One must remember that when a patient, be he partially or completely obstructed—and as far as this paper is concerned the word obstruction refers to partial as well as complete obstruction—comes for treatment we have on our hands a dehydrated, chronically poisoned patient whose whole cellular structure is altered chemically and physiologically by toxemia due to fecal stasis and that the amount of this toxemia we are at present incapable of evaluating. Hence, the great fundamental principle we have learned, and we were slow enough in learning it, is to forget about the carcinoma and treat the patient for the obstruction only. The carcinoma may be the primary disease, but it is only of secondary importance when the obstructed patient comes into the hospital and, furthermore, this idea must be presented by the attending physician or surgeon to the patient and to the relatives. They must be made to understand that a process which has taken weeks or months to develop cannot be corrected and the patient cured with the maximum of safety by one operation. The idea of multiple operations in order to get these people well is a factor that must be impressed on them.

At this point let me refer to some statistics prepared from my own private files. In this series of 49 cases of carcinoma of the colon and this does not include rectosigmoid carcinoma we have some very interesting facts. They should act as an incentive for earlier diagnosis for they give proof of very marked improvement in the management and treatment of the patients after they have become obstructed and if these results can be obtained after obstruction has developed one can easily imagine much better results if earlier diagnosis can be made. The 49 cases can be divided into two groups. The first group comprising 18 cases were patients who were hopeless for cure when their obstruction developed and all that could be done for them was some palliative operation. There was one death in this group from pneumonia. The second group comprise those cases in whom we hoped for cure and they were submitted to radical procedure. We had 31 cases in this latter group and 6 deaths attributable to the operation. Of these 31 there were 20 operated on before 1932 and all of the 6 deaths occurred in this group. There were 11 operated on since 1932 and there have been no deaths. These results have been brought about by better preparation and better judgment while operating. Of the 31 cases favorable for cure and operated on there are 15 alive or dead but who died from some other disease. The 16 other patients died of metastases. Therefore the curability of the disease as far as this analysis is concerned rests at 50 per cent of the operable cases. While these figures appear discouraging yet when one compares the results with 15 years ago they are really very encouraging and worth while. Let us remember that as physicians and surgeons we must bear in mind that while our aim is to cure the disease yet we have another duty to perform if we cannot cure and that is to keep the patient comfortable and happy as long as he lives. It is indeed sad that so many of these patients come to the medical attendant in partial or complete obstruction. Any patient with blood in the stools, griping pain or increasing constipation requires a very careful history taking and a careful examination supplemented by all the machinery at our disposal. In case all these examinations are negative and nothing is found the medical attendant should not allow this to warp his clinical judgment and act as a relative to his suspicious clinical science.

When obstruction is present the diagnosis is almost evident and the only object in our methods of examination at that time is to furnish us with information as to the site of the lesion and thereby a lead to treatment. As was mentioned in the

opening paragraph there is only one condition which may simulate intestinal obstruction and that condition is stone in the kidney and the great point in differential diagnosis in this type of case is tenderness which is elicited over the involved kidney by fist percussion in the flank as emphasized by the late Dr John B. Murphy. Patients with true large bowel obstruction come into hospital with a very greatly distended abdomen with the cecum distended and palpable and with a decided splashing sound when the abdomen is examined. A goodly number have nausea only but some have nausea and vomiting and nearly all complain of major discomfort in the region of the cecum due to distention of that segment of the bowel. A flat x-ray plate helps to confirm the diagnosis by showing the distended large bowel proximal to the obstruction and we can differentiate the condition from small bowel obstruction in which ladder pattern and fluid levels are diagnostic. A barium enema serves further to locate the site of the obstruction and this is all the investigation needed at this stage as we are not then interested in the carcinoma as we are out to defeat the effects of the obstruction.

In very such patients much may be gained and certainly nothing lost in delaying for 4 or 5 hours while the patient is given an intravenous injection of 1500 cubic centimeters of glucose in normal saline. Then we do a blind cecostomy.

While cecostomy is an extremely simple operation yet there are two points of importance. The incision of course is the ordinary grid in and the section of cecum selected should not compromise the ileocecal junction. The piece of cecum delivered should be about the size of a hen's egg and should be fastened to the skin only by four catgut sutures. A few interrupted catgut sutures placed in the balance of the skin incision suffice to close the wound. As a rule the bowel is not opened for 24 hours or better 48 hours but if the obstruction is very marked it may be opened by placing a tube in it at the time of operation. Before the bowel is opened it is wise to protect the skin at the bowel junction with vaseline gauze or other protective. We generally use a cautery at the end of 4 or 48 hours to open the cecum. Any but if a cautery is not available a very satisfactory method is simply to place a clamp in the knuckle of bowel wall at the time of operation and it is quite a simple matter at the end of 24 to 48 hours to cut the knuckle with a pair of scissors and release the clamp. After the bowel has been opened the next week or 10 days or even 2 weeks is spent in an effort to get the bowel cleaned out and to correct the patient's state.

About the second day after opening the cecum, irrigations are started per rectum and as a rule 2 or 3 days elapse before there is any sign of through-and-through wash. Normal saline is as good as anything else to use for the purpose of irrigation but sometimes 1 part of peroxide of hydrogen to 6 parts water is used, and we find it very useful for breaking up hard and impacted material, but occasionally it gives a patient a certain amount of abdominal discomfort. We usually instil into the cecum about 1 ounce of raw linseed oil daily. This helps to lubricate the tract. As soon as the edema at the site of the growth subsides then the bowel becomes patent as is evidenced by the through-and-through washing. At times there is excoriation of the skin around the cecostomy opening and if so the best thing to use to protect the skin is aluminum powder. It takes from 10 days to 2 weeks on this line of treatment to get the patient ready for the major procedure. In fact I prefer to have the patient up out of bed for a few days because I feel chest complications are less frequent.

We are now up to the point where our obstructed patient is cured, his vital forces have been revived and he now becomes the patient with carcinoma of the colon for which resection of the colon offers cure or at least palliation. If the patient's hemoglobin is below 65 per cent we give a blood transfusion, either the night before or immediately preceding his operation. Inasmuch as the lesion in a patient with obstruction may be located from the mid transverse colon to the sigmoid, we find the usual left rectus incision the one of choice. In difficult splenic flexure cases, I have deliberately made an incision at right angles to this into the left loin resulting in a T-shaped opening. To those who are doing this type of surgery I strongly advise their standing on the right side of the patient because it allows the visualizing and mobilizing of the splenic flexure or descending colon with much less effort. There are certain fundamental principles which are basic for all large bowel resections and they are: mobilization, preservation of the blood supply, absence of tension, prevention of soiling by some suitable technique. The first three are common to all types of procedure. If one of the so called aseptic clamp methods is used, the meticulous care for the prevention of soiling is not a problem. The Rankin and the Furniss clamps which are in use at the present time seem satisfactory when they are used properly. If, however, the surgeon has developed an excellent technique these clamps are found to have no advantage over the suture method.

There remains another method of resection which has a definite place and should be used by all surgeons under certain conditions, and this is the Mikulicz procedure. The three basic principles still stand for this method and the greatest of these is mobilization. This operation is almost imperative if one has to resect a portion of bowel filled with feces, for one will encounter such in cases where the irrigations have failed to clean. It may be used as a method of choice where a non-obstructing carcinoma is being removed, thereby reducing the operative treatment from a three-stage to a two-stage procedure. Like many other operations of surgery it is important to do it properly. In the first place one must make a good spur and in the second place this spur must be cut through completely by the clamp. Closure of the Mikulicz colostomy is greatly facilitated if at least one inch of bowel has been left redundant to the skin at the original operation.

Nothing has been said regarding the methods used in carcinoma of the cecum or ascending colon. These do not come within the scope of this paper. They are not obstructing and we do practically all of them in one stage with a mortality rate which is nil. Occasionally one encounters a case of carcinoma of the ascending colon where an end-to-side join-up between the transverse colon to terminal ileum is the first stage and a resection 10 days later the second stage.

Following the resection operation, unless it be the Mikulicz procedure, all irrigations are discontinued. At the end of 5 or 6 days 4 ounces of linseed oil is injected per rectum and repeated every second day. The patients are usually out of bed at the end of 2 weeks and are sent home for 2 months before closing the cecostomy. We have made the mistake of closing the cecostomy too soon before the edema at the site of the anastomosis has had time to disappear and hence become firm. The result was partial obstruction, a leak, local peritonitis, or a breakdown of the cecostomy closure.

The cecostomy closure is, as a rule, a simple procedure. The bowel is liberated from the skin and then closed with three layers of sutures. This is then liberated from the deeper structures, that is the external oblique aponeurosis, the internal oblique and the transversalis muscles but not from the peritoneum, so that the line of closure is extraperitoneal and the danger of peritonitis is avoided. I have dropped many cecums back into the abdominal cavity and have had no bad luck follow but other surgeons have had, and when competent operators report such we should pay attention to their advice and leave the line of

suture in the cecum extraperitoneal. The wound is repaired as the usual grid iron incision. Healing as a rule takes place by primary union and the patients are up at the end of 10 days.

#### CONCLUSIONS

1. Our next step forward in increasing the curability of carcinoma of the colon must be aimed at getting the patients before the advent of partial obstruction.

2. Any patient with constipation requires careful history taking.

3. Given a patient with increasing constipation, cramp like pain, blood which is not due to piles or polyps, and with negative x ray and sigmoidoscopic examination, carcinoma must be the diagnosis until proved otherwise.

4. Exploratory laparotomy would seem justifiable as a diagnostic procedure which may prove curative.



# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.  
Founder and Managing Editor  
1905-1935

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ALLEN B. KANAVEL, M.D.	Editor
LOYAL DAVIS, M.D.	Associate Editor
DONALD C. BALFOUR, M.D.	Associate, Editorial Staff

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OCTOBER, 1936

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### EDEMA IN SURGICAL PATIENTS

**I**NCIDENT to certain surgical conditions of the gastro-intestinal tract, prolonged periods of starvation are likely to occur. As a result of this starvation there is a reduction in the total blood serum protein which is found chiefly in the serum albumin fraction. After the total serum protein or albumin is reduced to what has been termed a "critical level," edema develops which can be first detected clinically in the dependent portion of the body, in the scrotum, and about the ankles.

Edema in surgical patients is an especially pertinent subject at present because of the popularity in recent years of the method of giving fluids by continuous infusion. It is now generally recognized that too much fluid may be given to patients especially if it contains sodium chloride.

Long ago Starling advanced the hypothesis that edema is explained by a variation in ex-

change of water between the blood and tissues as determined by a balance between the hydrostatic pressure in the capillaries and osmotic pressure of plasma protein. The blood and tissue protein balance is disturbed by starvation. If the blood serum total protein drops to 5.5 grams per 100 cubic centimeters or the serum albumin is reduced to 2.5 grams per 100 cubic centimeters, edema is likely to develop. Weech and his associates<sup>1</sup> found in their experiments that edema was not produced in the absence of sodium chloride intake. Shelburne and Egloff<sup>2</sup> lend their support to this conclusion by indicating that the sodium ion is the edema producing element rather than the chloride ion. These experimental findings definitely indicate that sodium chloride and Ringer's solution should be used with care and discretion to prevent the development of edema in those surgical patients to whom protein cannot be given by mouth.

In a series of surgical patients Jones and Eaton<sup>3</sup> have shown that a reduction of protein intake, profuse surgical drainage, the general effects of sepsis, and the loss of serum protein by massive hemorrhage, all predispose to edema when excessive quantities of fluid and sodium chloride are given. These authors note also that undernutrition with protein deficiency may be associated with a normal or high figure for serum protein without the development of edema, unless sufficient quantities of fluid and salt are administered to pro-

<sup>1</sup>Weech A. A. Snelling C. E. and Goettsch E. J. Clin Investigation 1933 12 193

<sup>2</sup>Shelburne S. A. and Egloff W. C. Arch Int Med. 1931 48 51

<sup>3</sup>Jones, C. M. and Eaton F. B. Arch Surg 1933 27 159

duce edema. In a group of unpubl. hcd peritonitis cases Dr W. C. Curphey and I have found that edema will frequently develop in from 5 to 10 days after repeated daily infusions of 5 per cent dextrose in physiologic sodium chloride or Ringer's solution. Any evidence of edema in such a patient is a signal to readjust his fluid and salt intake. The edema will usually disappear if the total fluid intake is reduced and the sodium chloride is entirely discontinued.

With a continuous loss of chloride in patients treated by continuous gastric suction such patients should have frequent estimations of their blood chlorides so that the sodium chloride content of the body may be maintained within normal limits. Since the average normal daily intake of sodium chloride is 5 to 6 grams it is readily understood that an intake of 3,000 cubic centimeters of physiologic salt solution or 27 grams of sodium chloride might result in an excess in the tissue even though there is a continuous loss by gastric suction and lavage.

To supply sufficient protein to prevent edema to those patients who cannot take food by mouth is a problem yet unsolved. Transfusions are of some value but blood in enormous quantities would be required to maintain a normal serum protein level in starvation.

While the true danger of edema incident to low serum protein has not yet been established it seems clear that such a disturbance of the body chemical balance cannot be anything but detrimental to the recovery of an ill patient. It forces the realization that parenteral feeding and watering of patients should not be continued beyond the time when it is absolutely necessary and that the development of some method for the administering of protein to such patients is very desirable.

THOMAS G. ORR

## PAIN

**T**HIS question, what is pain, is no idle remark and its answer is by no means easy.

Pain is at least an experience we have all had. We know approximately what we mean when we use the term and that is something even if we are uncertain whether it should be considered an entity or a state of mental receptivity.

My first point is the obvious one, the protective value of pain.

The ability to feel pain has the greatest protective value—not so the pain itself. Suppose we forget the warning effect of pain and the fear of pain in some well intentioned effort to remedy a local state may we not inflict a trauma on the nervous system (especially in children) from which it may never wholly recover?

We recognize this in our association of pain with shock, pain and spasm of muscles about an injury, pain and blanching of the face and the starting of sweat on the body surface and a thousand others. May it not also adversely affect healing, recovery from disease and certainly the taking of food and rest and do we not sometimes forget the frequently dominant importance of relieving pain in disease and injury?

The physiology of pain is very complicated. The perception of pain is something experienced, a mental activity and therefore profoundly influenced by the mental state at the moment of the experience. To initiate this mental activity this experience of pain there must be a stimulus and an incoming impulse from the periphery to the brain. The character of the stimulus probably has no influence on the impulse except in so far as it may affect many nerve endings and the frequency of reiteration of the impulse.

After long dispute, it is now known through the work of Davis and Pollock, that all sensory impulses, whether from the cerebrospinal or the sympathetic nervous systems, enter the cord through the posterior root and if sufficient posterior roots are cut all sensation painful and otherwise is abolished. It is, however, not always realized how much is the overlap in the distribution of sensory nerves.

It was also believed for many years, in fact until quite recently, that pain was not perceived through the sympathetic nervous system, because it is quite possible to cut, burn, or crush the exposed viscera without causing pain—this in spite of the common experience of intestinal colic. It is now known that medullated fibers undistinguishable from cerebrospinal nerve fibers are found in the visceral sympathetic trunks. They are of the afferent somatic type and are called by White, viscerosensory nerves. They do not synapse in the sympathetic ganglion but run in continuity from the sense organs in the viscera through the white rami to their trophic cells in the posterior root ganglia. Their central processes enter the posterior horn of the spinal cord. They are, therefore, identical with the cutaneous sensory fibers. It is now generally conceded that ingoing impulses through their fibers are perceived as pain, if the appropriate stimulus is applied. This stimulus is usually excessive extension or contraction.

Wherein lies the difference? It is necessary that the stimulus of cutting, tearing, or burning be perceived as pain, in order that we immediately avoid its continuance or repetition. It is not necessary for the welfare of the individual under normal conditions to guard against such injury to the visceral organs but it is necessary that the intention should shout a warning if irritating substances are put into it, and, it does. Moreover, it is necessary that

we locate with accuracy the point of injury on the surface. Hence we train the peripheral spinal nerves to localize the point of injury but we localize with far less accuracy an irritation of the viscera.

These two systems are moreover closely associated. If we believe with Paul White that the viscerosensory nerves are identical anatomically with cerebrospinal sensory nerves, then we can easily understand that, under the appropriate stimuli, pain may be received from the visceral organs as directly as from the skin and this is probably true. If this be true it explains many curious observations, such as the common observation of an area of hyperesthesia in the cerebrospinal distribution of a nerve in the same somatic segment as a diseased visceral organ. From the diseased organ stimuli are going in which reach the painful area but do not reach the threshold of pain perception. Add to this, pressure which would not normally cause pain, and the result may now be pain, and we say that the skin is hyperesthetic. The pain will be perceived as coming from the normal skin surface and may be made to disappear in one of three ways. The recovery of the diseased organ, the blocking of the ingoing cerebrospinal pathways with novocain, or the interruption of the ingoing sympathetic fibers. In each case there is a lowering of the tension or volume of the ingoing stimuli along the pain paths of the cord. Today all of these methods are in use for the relief of pain.

May I express my own belief that one can educate the brain to perceive as pain ingoing stimuli from the viscerosensory nerves which are not usually so perceived. Let us begin to be distrustful of our interpretation of pain manifestations and less sure that what does not hurt me, will not hurt my neighbor, that what does not hurt today will not hurt tomorrow. Let us realize that expected pain in-

creases its severity that continuous or recurring pain may increase its actual perception

Let us try to understand and through understanding treat rationally and above all let us spare pain by every means we can particularly long continued and reiterated pain not only out of kindness but for its actual influence on the progress of disease

Let us scrutinize our methods whether of treatment or examination If we can by no means avoid causing pain especially recurring pain be very sure that the benefit more than balances the evil I submit that a procedure which of necessity causes pain particularly reiterated pain is nearly always wrong

F A C SCRINGER





*Herb's Day*

# MEMOIRS

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CHARLES HARRISON FRAZIER

ON April 19, 1870, Charles Harrison Frazier was born in Philadelphia. His father, W. W. Frazier, had served with honor as captain in the sixth Pennsylvania Cavalry during the War of the Rebellion. After that war he had taken a prominent part in the social and business life of his city. His mother, Harriet Morgan Harrison, came of a family long prominent in civic affairs and closely connected in their interests with the University of Pennsylvania.

After graduating from the Episcopal Academy in Philadelphia in 1886 and receiving his A. B. degree from the University of Pennsylvania in 1889, Dr. Frazier cast about for a career. His two elder brothers, George and William, having entered the Franklin Sugar Refining Company with their father, his mother insisted that he choose a profession. He agreed to enter the medical school of the University of Pennsylvania for a year to discover whether or not he found medicine sufficiently interesting to pursue it farther. He graduated from the medical school in 1892, serving internships in the University and Episcopal Hospitals in 1892-94 under Drs. J. William White and John Ashhurst. Since surgery and surgical pathology interested him, he spent the year 1895 in Germany studying under Virchow and von Bergmann. In recognition of this careful training, on his return to Philadelphia he was appointed to the surgical staff of the University Hospital and to the teaching staff of the medical school. In 1901 he was appointed professor of clinical surgery and dean of the medical school of the University of Pennsylvania. During his term of office 1901-1910 important developments and changes in the character and purpose of medical education appeared. His eager and active mind, impressed by his experiences in Germany, was thoroughly in accord with the more advanced ideas. His every effort was directed toward bringing the faculty and their methods of teaching up to the newer standards. An idea of his activities can be gained when it is realized that in addition to his duties as dean he carried on an active surgical practice and established and edited the *University of Pennsylvania Medical Magazine*.

Through his association with the Philadelphia neurologists, Dr. S. Weir Mitchell, Dr. C. A. Mills, and especially his classmate in the medical school, Dr. William G. Spiller, Dr. Frazier soon became interested in neurological surgery. In

1900-1901 with Dr Spiller he showed by experimental work on animals that preganglionic section of the sensory root of the fifth nerve was never followed by regeneration of the root. In 1901 he cut the sensory root of the trigeminal nerve for the relief of pain in tic douloureux the first time that his procedure had been carried through successfully. From this research and clinical observation came forth the modern operative treatment of major trigeminal neuralgia. In 1903 in conjunction with Mills de Schweinitz and Weisenberg he published a monograph on Tumors of the Cerebellum in which he could report 6 cases of suboccipital craniectomy with 5 recoveries in 3 instances following complete or partial removal of the tumor—a much better record than any previously published.

While during the next 15 years he busied himself with general surgery neurosurgery and thyroid surgery were his particular interest. In recognition of his leadership in neurosurgery he was in 1918 a consultant to the surgeon general in charge of the neurosurgical service at Base Hospital No. 11 at Cape May and No. 41 at Fox Hills Staten Island. He represented the surgeon general at the Inter Allied Surgical Conference in Paris in 1920 presenting a paper on the results of the treatment of injuries to the peripheral nerves.

In 1912 he was appointed John Rhea Barton professor of surgery in the University of Pennsylvania School of Medicine. His ability as an organizer was at once apparent. Within 3 years he had infused new life into the department established fellowships for the teaching of young men and correlated properly the clinical and research activities.

But surgery by no means held his entire attention. In 1910 he established with others the social service department in the University Hospital the second perhaps in this country. In 1914 he organized the Public Charities Association of Pennsylvania and gradually developed it into a state wide group to the great betterment of the care by the state of its handicapped feeble minded insane and penal classes. And for this important public work he was always willing to sacrifice his time and no effort was too great to further its interests.

Many honors came to him. He was a member of the College of Physicians in Philadelphia a founder member and president (1925-1927) of the Society of Clinical Surgery a founder member and president (1922-1923) of the Society of Neurological Surgeons a member and president (1928-1929) of the American Neurological Association a fellow of the American College of Surgeons a member of the American Surgical Association the American Society for the Study of Cointer of the Deutsche Akademie der Naturforscher and an honorary member of the British Neuro Surgical Society. He received the degree of Sc D from the University of Pennsylvania in 1925 and in 1934 was elected a trustee of that University.

Dr Frazier was a voluminous writer as over 200 contributions to medical literature two monographs and a textbook on the *Surgery of the Spine and Spinal*



*Cord testify* His two outstanding achievements were his development of the surgery of the trigeminal nerve and section of the anterolateral columns of the spinal cord (cordotomy) for relief of pain. But his work on the surgery of the pituitary gland and on suture of the recurrent laryngeal nerve is important.

He was an indefatigable worker, a close economizer of his time and efforts. He had an uncanny ability to strip a problem of its non-essentials and a keen eye for the basic facts. Always driving himself, he expected as much from those around him although after he applied the spur he always had just the right words of appreciation. But he did not suffer fools gladly nor did he have time to waste in argument once he had reached his own conclusions. Hence those who did not know him well found him short and decisive.

But those of us who were privileged to know him well and to work with him for a long time entertained a tremendous respect for his judgment and a high regard for him as an older companion. Four particular attributes stand out: his fine sense of values, his justice, his geniality and whole-heartedness when off duty and at ease, and his devotion to his family. To have as full and busy a career as he did and at the same time never sacrifice his family on the altar of his ambitions is the best possible testimony to his sense of proportion.

In 1901 he married Mary Spring Gardiner of Albany, New York. Mrs. Frazier died in 1920. Four children are living: Mary, now Mrs. Richard H. Meade, Charles Harrison, William Doane, and Nalbro. Dr. Frazier died at his summer home in North Haven, Maine, July 26, 1936.

For two years he knew the nature of his illness and what he had to face. For the last 8 months he was in constant pain. Up to the end he took an active interest in all his affairs uncomplaining, cheerful, keen. He died as he had lived—looking forward, always courageous.

FRANCIS C. GRANT

In  
 As Dr. Alfred Bledsoe has been recommended as Surgeon  
 your Regiment as I years State and as the Surgeon of  
 your Reg't at he gives such Encouragement that if he  
 can be properly recommended by a Surgeon acquainted with  
 abilities he may have a Place in said Regiment  
 I cheerfully recommend him to your Friend as  
 a Surgeon who has been several years in the Study of Surgery  
 and Surgery part of which time he has many great and  
 valuable Advantages from the Practice of the Hospitals  
 both Regular, and as a Surgeon from his Application to Prof  
 ness and Attention to my reverence from with great (and true  
 declare it is my Opinion, that he is well qualified for the  
 Office of State and that he will serve in that Capacity  
 to the Satisfaction of yourself and all other Officers  
 of the Battalion I am for of my humble servant  
 John Warren  
 Brookland Langfellow  
 General Hospital July 14 1776

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE day has long passed when one man can write a textbook of neurology and psychiatry. Such works are usually compilations, and are often strongly pervaded with the musty odor of lamp and library. Their contents never seem quite alive to the reader, but rather give the impression that the author has dressed up an old corpse with his own particular style of rhetoric. It is, therefore, an event when there appears a work on neurology and psychiatry, each topic of which is discussed by a writer who has made that subject a special held of concentration. The result is a document which bristles with first hand knowledge and is alive with useful, practical information. Such a book is volume ix, *Neurology and Psychiatry, of The Practitioners' Library of Medicine and Surgery*.<sup>1</sup> Among the contributors may be mentioned Cornwall (pyogenic meningitis), Craig (tumors of the spinal cord), Critchley (muscular dystrophies), Globus (malformations of the nervous system), Kennedy (head injury), Lennox (epilepsy), Peet (neuralgias), Raley (migraine), Solomon (neurosyphilis), Yakovlev (congenital ectodermoses), Grant (brain abscess), Brickner (multiple sclerosis), Bowman (psychoses due to drugs and toxins), Myerson (psychopathology). This volume reflects well recent advances and contemporary thought in neurology and psychiatry and should prove useful as a reference book for the general practitioner and as a handbook for the graduate student.

HARRY A. PASKIND

A SHORT outline discussing the various types of tuberculin and their preparation and giving detailed instructions in making the various tuberculin tests will be found in *The Tuberculin Handbook*<sup>2</sup> by Sutherland. In addition, unusual stress is placed on the use of tuberculin in diagnosis.

With due respect to the author's clinical knowledge of this subject it will probably be found that there is considerable difference of opinion among clinicians in this country as to the importance and reliability of the tuberculin reaction as an indication of clinical tuberculosis.

The book will serve as a handbook for students and practitioners, and as such is very well presented.

J. A. BRITTON

<sup>1</sup>THE PRACTITIONERS' LIBRARY OF MEDICINE AND SURGERY. Vol ix—NEUROLOGY AND PSYCHIATRY. New York and London: D. Appleton-Century Co., 1936.

<sup>2</sup>THE TUBERCULIN HANDBOOK. By Halliday Sutherland, M.D. London: Oxford University Press, 1936.

THE fifth edition of Herbert French's *An Index of Differential Diagnosis of Main Symptoms*<sup>3</sup> is now available. The first edition appeared in 1912 and the last edition of 1928 was reprinted in 1929. The present volume follows the previous policy of alphabetical arrangement of topics which are discussed differentially. The present volume of 1145 pages is about 200 pages larger than the edition of 1920. The chief reason for the gradual enlargement is due to the increasing mass of diagnostic points in medical literature and due to the addition of more illustrations, notably, roentgenograms. Many of the diagnostic points and methods are of the English manner and are not well adapted to modern American teaching. However, it continues to be a splendid volume, crammed with excellent, practical material for use in differential diagnosis by the student and practitioner.

M. HERBERT BARLER

IT is very comforting to have a new addition of DuBois' *Metabolism in Health and Disease*,<sup>4</sup> and to find new material of fundamental importance incorporated. The chapter on the "Mechanism of the Loss of Heat from the Body" has been entirely reconstructed and the subject of radiation is reported in detail. This has been required by the work of others but actually also by the investigations and methods devised by the author and his co-worker, J. D. Hardy. The section on standards of normal metabolism includes the work of Boothby, Dunn and Berkson, which is to be published in 1936. Hence, this volume contains the results of the latest and most extensive study of metabolic standards which has yet been made.

The first division of the book "Metabolism in Health" begins with the following subject—history, a discussion of the metabolism of carbohydrate, fat and protein, a brief review of certain laws of physics involved in the operation of metabolism machines, a study of the mechanism of heat loss, and the gases of the body. The second part of the first division is particularly valuable to technicians. It covers the general principles of respiration apparatus and the methods of calculation, the estimation of the surface area of the body, factors which influence the normal

<sup>3</sup>AN INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS. By various writers. Edited by Herbert French, C.V.O., C.B.E., M.A., M.D. (Oxon.) F.R.C.P. (Lond.). 5th ed. Baltimore: William Wood & Co., 1936.

<sup>4</sup>BASAL METABOLISM IN HEALTH AND DISEASE. By Eugene F. DuBois, M.D. 3d ed. Philadelphia: Lea & Febiger, 1936.



It is surprising how completely this book of 160 pages covers the field. Each chapter is written in an individual way, never schematically nor dogmatically, according to practical needs and the special considerations of the tumors under discussion. The book stresses the special responsibilities and possibilities of early diagnosis of malignant disease for the general practitioner through brief reference to the chances of cure in various stages of the disease. It is concise, complete, and very readable. It is correct in every detail and reflects the modern position in all questions discussed.

This book should be studied carefully by every medical student and practitioner. It will then play its very valuable part in improving the conditions for the early diagnosis of malignant disease as far as this depends on the physician. MAX CUTLER

IN the introduction to his book,<sup>1</sup> which is a fine example of scholarly research, Dr Himes modestly explains that "the publication of a medical history by a sociologist proceeds from no desire to usurp a medical function but rather from a sincere effort to contribute some measure of perspective toward the understanding of a human problem which, after all has implications not alone for medicine but for human biology, for economics, sociology, jurisprudence, and many other fields of human knowledge and endeavor." To say that he has admirably succeeded in this effort sums up the spirit of this review.

It should be emphasized that only the attempts to prevent conception are traced in this survey. Histories of medicine, in general, have been conspicuously silent on the subject although evidence is offered that contraceptive efforts began several thousand years ago. The author shows that the desire for prevention of pregnancy has been present in many societies widely separated in space and time. This answers the claims that certain propagandists are responsible for "birth control" especially since there is no evidence of any such organized propaganda prior to 1822. The author infers, from its universality and antiquity, that anticonception "fulfills some fundamental human need. It has shown great sticking power. It has not only survived, it has grown increasingly strong."

This book consists of the following parts: (1) Contraceptive Technique before the Dawn of Written History, (2) Contraceptive Technique in Antiquity (Western World), (3) Contraceptive Technique in Eastern Cultures, (4) Technique in the West during the Middle Ages and Early Modern Times, (5) Democratization of Technique since 1800 in Eng-

land and the United States, (6) Democratization and Its Future Effects.

The wealth of collected material is always interesting and not infrequently amusing. The ancient Indian suggestion that "Elephant dung mixed with honey and placed in the vagina of a woman prevents conception" and the old Greek recommendation that "The woman should carry as an amulet around the anus the tooth of a child or a glass from a marble quarry" are diverting.

Speaking of the more bigoted and emotional types of opposition from religious bodies, Dr Himes states that they are not entitled to a hearing in scientific circles both because they are usually uninformed and because their assumptions and methods are unscientific. "It is time that we refused to be stampeded and cajoled by Roman metaphysics."

The volume is a very real contribution to the history of medicine and will be indispensable to anyone genuinely interested in its subject. JOHN FAVILLE

A CONCISE and clear summary<sup>2</sup> of the most important works that aim to establish facts concerning the time of ovulation in women, has been prepared by Hartman. The volume of 200 pages with its graphs and illustrations will provide an evening of excellent entertainment, at the end of which one will have acquired a better working knowledge of the subject. In the first nine chapters Hartman describes the male and female cell of reproduction, ovulation, fertilization, and menstruation, the remainder of the volume is devoted to the time of ovulation. All data that have any bearing on this phenomenon have been carefully studied by the author, his interpretation of the results obtained by some other workers differs from theirs. The following subjects have been considered in their relationship to the time of ovulation, namely, woman's introspection, hormone levels, inspection of ovaries, microscopy of vagina and uterus, fixed dates, finding the free eggs, the age of human embryos, and the fertile period in monkeys. Each subject is discussed briefly and concisely. All known factors are considered and the "unknown quantity" stressed. Hartman believes the Knaus method of testing the reactivity of the uterus to pituitrin is "the most promising objective method" at hand. However he points out that this method lacks confirmation.

Anyone familiar with Dr Hartman's unparalleled work on reproduction in the monkey will readily appreciate the value of this volume.

CHESTER C. DOHERTY

<sup>1</sup>MEDICAL HISTORY OF CONTRACEPTION. By Norman Himes, Ph.D. Medical Foreword by Robert Latou Dickinson, M.D. F.A.C.S. Baltimore: The Williams and Wilkins Co. 1936.

<sup>2</sup>TIME OF OVULATION IN WOMEN. A STUDY ON THE FERTILE PERIOD IN THE MENSTRUAL CYCLE. By Carl G. Hartman. Baltimore: The Williams and Wilkins Co. 1936.

## BOOKS RECEIVED

Books edited and acknowledged the department and such acknowledgment is to be regarded as a sufficient return for the courtesy of the section. Selection will be made for review in the interests of our readers and space permits.

PERIPHERAL GYNECOLOGY By J. L. Bub MD FACS Baltimore & William Wood & Co 1935

GYNECOLOGY FOR NURSING By J. Ry St. George MD and Robert Jan. s. Crossen MD died. St. Louis The C. V. Mosby Co 1936

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ESSENTIALS OF COSMETOLOGY By H. O. Ban. s. MD Los Ang. l. Calif. mas

PRINCIPLES AND PRACTICE OF RECTAL THERAPY FOR THE M. TALLY ILL. By J. L. L. e. d. S. B. A. M. A. In coll. b. ation w. th Dr. W. liam. Rush. D. Dion. Jr. New York A. S. Barnes & Co 1936

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MINOR SURGERY By Fred. n. ch. Christ. ph. r. S. B. MD FACS 3d. d. Philad. Iphia and Lond. n. W. B. Saunders Co 1936

LABORATORY CHALLENGE ILLUSTRATED By V. i. t. r. Pa. chet. Fasc. ule. 2. Pa. s. C. Don. n. d. Cie 1936

A DESCRIPTIVE ATLAS OF RADIOGRAPHS By A. l. Bert. s. ile. M. B. Ch. B. F. R. C. S. (Ed.) St. Lo. is. Th. C. V. Mo. by. Co 1936

APPEALING BY W. J. St. w. r. t. McKay M. B. M. Ch. B. C. Sydney Australia Ang. & R. heitson Ltd 1936

DIE VITAMINEN DER MILCH UND BESONDERER BERÜCKSICHTIGUNG DER FRACHMILCH. By P. D. Fr. med. W. li. r. N. u. e. l. e. B. m. Hans. l. ber. 9. 6

DIABILITY EVALUATION PRINCIPLES OF T. AIME. FOR COMPE. SABLE I. J. R. L. I. K. S. By E. I. D. M. Br. d. B. S. MD FACS Philad. Iphia, London and M. t. eal. J. li. L. i. p. i. cott. Co 1936

VASCULAR DISORDERS OF THE LIMBS By S. r. Th. mas. Lew. s. N. w. York The Macmillan Co 1936

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SLEW AND SUPPLE, A NEW SYSTEM OF STETHO. R. ENF. CI. ES. By B. bro. Leif. er. Eg. cl. Tra. l. i. t. ed. by G. ta. Olsson M. R. C. S. L. R. C. P. New York D. W. i. l. l. i. n. Cent. ry. Co 1936

VITIS HA. B. CH. DER G. N. A. KOLO. I. E. 3d. e. n. l. d. Fl. u. t. ed. by W. Sto. eck. e. l. i. x. De. Bed. t. ung. n. u. Sek. t. n. fu. r. d. F. nh. l. i. k. u. d. By W. B. t. i. ng. C. Cla. u. b. e. J. L. J. Kra. M. ch. J. F. B. g. man. 1936

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VASCULAR DISORDERS OF THE LIMBS By S. r. Th. mas. Lewis, CBE. FRS MD DSc LL.D. FRCP New York The Macmillan Co 1936

SURGICAL DISEASES AND ILLNESSES OF THE GENITOURINARY ORGANS By S. r. J. hn. Thomson Walke and ed. re. L. d. d. by Kenn. eth. W. li. M. A. M. B. B. C. (Can. tab.) F. R. C. S. Balt. i. m. r. W. liam. Wood & Co 1936

CONTRACEPTION A THERAPEUTIC MEASURE. By B. e. s. e. L. M. es. MD Balt. i. m. W. liam. & W. li. s. C. 1936

POCKET MONOGRAPHS ON PRACTICAL MEDICINE AND SYMPTOMS OF OBSTETRICAL DISEASES AND TREATMENT IN GENERAL PRACTICE By B. thel. Sol. m. MD FRCPI FCOG 1st. and 2nd. London John B. l. S. n. & Da. n. i. s. son. Ltd 1936

ENDOCRINOLOGY IN MODERN PRACTICE By W. liam. W. H. M. D. MS Philad. Iphia W. B. Sau. nders. C. 1936

TECHNIQUES CHIRURGICALES By A. Go. set. t. L. P. n. Mass. on. et. Cie 1936

A BEST PRACTICE GUIDE DER SCHWANGERSCHAFT WEREN. ARBEIT W. H. E. A. T. M. C. SCHW. A. C. S. C. H. R. A. T. U. S. M. I. S. S. E. L. ARBEIT By D. med. F. i. l. i. x. S. h. l. B. li. n. S. K. e. r. 1936

WILLIAMS' OBSTETRICS ETC. By H. n. e. s. J. Stand. r. MD FACS 7th. d. N. w. Y. k. and Lo. n. d. Appl. t. Ce. t. u. r. y. Co 1936

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OXFORD MEDICAL ILLUSTRATIONS THE ANEMIAS By Jan. t. M. V. g. ha. D. M. O. n. M. R. C. P. Lo. d. W. th. N. e. s. N. e. m. and J. i. b. i. g. n. a. l. L. y. th. po. s. s. by H. bert. M. T. r. m. b. l. l. D. M. O. F. R. C. i. Lond. d. d. Lo. do. Oxf. d. La. n. s. t. y. Press 1936

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CLINICAL MEDICINE A SERIES OF LECTURES AND THE H. T. V. OF MEDICINE Edited by L. B. K. m. ba. ar. MD u. m. G. i. c. o. l. o. g. y. A. d. O. b. s. t. r. i. t. i. s. By Ed. M. J. m. e. s. MD New York L. u. l. B. Ho. e. b. e. r. In. 1936

THE SCIENCE OF THE RUBE. L. K. I. M. S. D. Sc. Spr. i. ng. h. l. l. l. l. and B. li. m. e. C. h. a. r. l. e. s. t. Th. mas. 1936

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LA CH. I. D. U. C. E. D. R. O. L. U. M. By O. Lamb. t. H. M. i. t. y. and J. D. r. e. s. s. e. P. i. Mass. o. t. t. e. 1936

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# CLINICAL CONGRESS AMERICAN COLLEGE OF SURGEONS



*Twenty-Sixth Annual Session*

PHILADELPHIA, OCTOBER 19-23, 1936



DONALD C BALFOUR, M D , Rochester, Minn , *President*

EUGENE H POOL, M D , New York, *President-Elect*

*Committee on Arrangements*

HENRY P BROWN, JR , M D , *Chairman*

GILSON C FINGEL, M D , *Secretary*

# AMERICAN COLLEGE OF SURGEONS

## PROGRAM FOR THE 1936 CLINICAL CONGRESS IN PHILADELPHIA

### CLINICAL CONGRESS PROGRAM IN BRIEF

Monday October 19

- 9:30 H. pital conference—Rose Garden
- 2:00 Clin. n hospital
- 2:00 H. pital conf. nce—Rose G. d. n.
- 2:00 Surgical film exhibition—Irvi Hall
- 8:15 Irvi Hall

Tuesday October 20

- 9:00 Clinics n hospital
- 9:30 Hospital ride —P. se G. rden
- 1:00 Surgical film exhibition—Palm Garden
- 1:00 Clinics n hospital
- 2:00 H. pital conf. —P. n. y. l. am. Hospital
- 2:00 Surgical film exhibition—P. l. m. G. d. n.
- 3:00 Fracture conference—Rose Garden
- 3:30 State and p. nci. l. execut. comm. ti. s—O. k.
- 5:00 Stat. and p. nci. l. execut. comm. ti. s—O. k.
- 8:00 Hospital conference—Oak Room
- 8:5 Sci. n. tific. se. on. gene. l. g. ry. n. d. o. l. a. r. y.
- 8:5 Sci. n. tific. se. on. ph. thal. m. i. g. y. n. d. o. l. a. r. y.
- 8:5 Sci. n. tific. se. on. ph. thal. m. i. g. y. n. d. o. l. a. r. y.

Wednesday October 21

- 9:00 Clinics n hospital
- 9:30 H. pital conf. nce—Rth. Card. n.
- 1:00 Surgical film exhibition—Palm G. d. n.
- 3:00 State and p. nci. l. jud. ci. a. r. y. comm. ti. s—Oak Room
- 2:00 Clinics n hospital
- 2:00 H. pital conf. nce—S. i. j. eph. H. pital
- 2:00 Surgical film exhibition—P. l. m. G. d. n.
- 2:30 Conf. n. n. Indu. trial. M. d. i. c. i. n. e. d. T. u. m. i. c.
- 3:00 Surg. y.—R. se. G. d. n.
- 8:00 Community health meets g.—Municipal Aud. t. n.
- 8:5 Sci. n. tific. se. on.—Irvi Hall

Thursday October 22

- 9:00 Clinics n hospital
- 9:30 H. pital conf. nce—Rose G. d. n.
- 1:00 Surgical film exhibition—P. l. m. G. d. n.
- 1:00 An. l. m. u. f. R. se. G. d. n.
- 3:00 Clin. n hospital
- 3:00 H. pital conf. nce—O. k. Room
- 3:00 C. l. n. n. can. r. l. —R. se. C. d. n.
- 3:00 Surgical film exhibition—P. l. m. G. d. n.
- 3:00 Sci. n. tific. se. on. n. l. g. y. l. n. H. l. l. y. n.
- 8:5 Sci. n. tific. se. on. n. l. g. y. l. n. H. l. l. y. n.
- 8:5 Sci. n. tific. se. on. n. l. g. y. l. n. H. l. l. y. n.

Friday October 23

- 9:00 Clin. n hospital
- 9:00 Surgical film exhibition—P. l. m. G. d. n.
- 9:00 M. l. g. l. New F. l. w. l. s. s. f. 936—k. se.
- 9:00 G. d. n.
- 2:00 Clinics n hospital
- 2:00 Surgical film exhibition—P. l. m. G. d. n.
- 2:00 C. c. r. Symposium—R. se. G. d. n.
- 8:5 C. n. o. c. al. —Irvi Hall

THE surgeons of Philadelphia are planning a highly attractive program for the twenty sixth annual Clinical Congress of the American College of Surgeons to be held in that great medical center October 19-23. The local Committee on Arrangements expects to present for the entertainment of the Fellows of the College and their guests a program of operative clinics and demonstrations at the hospitals and medical schools that will provide a most complete showing of their clinical activities in all departments of surgery. The Committee is assured of the hearty co-operation of the clinicians at the five medical schools and more than forty hospitals participating in the program.

A preliminary schedule of these clinics and demonstrations as prepared by the Committee is presented in the following pages which is to be further revised and amplified. Operative clinics and demonstrations in the hospitals are scheduled for the afternoon of Monday October 19 begin ning at 2 o'clock and for the mornings and after noons of each of the four following days. The final program of the Congress will be published from day to day—a complete and accurately detailed program being posted in the form of bulletins at headquarters in the Bellevue Stratford Hotel each afternoon for the succeeding day and issued in printed form the following morning. All departments of surgery will be represented therein—general surgery, gynecology and obstetrics, genito-urinary surgery, neurosurgery, orthopedics, surgery of the eye, ear, nose and throat.

Special features of the clinical program which the committee expects to develop include (1) Cancer clinics demonstrating the treatment of cancer by surgery, radium and x-ray (2) fracture clinics presenting modern methods in the treatment of fractures (3) clinics in traumatic surgery representing the newer methods of rehabilitation of the injured by surgery and physical therapy.

The showing of surgical motion pictures demonstrating clinical features of interest has met with popular acceptance in recent years and will be continued at this year's Congress with an enlarged program of films both sound and silent.



to be exhibited each morning and afternoon at headquarters

A number of distinguished surgeons from foreign countries are expected to attend the Congress in Philadelphia including the following Sir James Walton, London, England, William F Shaw, Manchester, England, Archibald H McIndoe, London, England, Alexander MacLennan and Archibald Young, Glasgow, Scotland, Josef Halban, Vienna, Austria, Paul Clairmont, Zurich, Switzerland, Wolfgang Rosenthal, Leipzig, Germany, F Sauerbruch, Berlin, Germany, and Rodolfo E Pasman, Buenos Aires, Argentina

#### EVENING MEETINGS

Programs for the five evening sessions are presented in the following pages All of these sessions are to be held in Irvine Hall

At the presidential meeting on Monday evening, following the introduction of distinguished guests from abroad, the retiring president, Dr Donald C Balfour, of Rochester, will deliver an address which will be followed by the inauguration of the new officers Dr Eugene H Pool, New York, president, Dr Emile F Holman, San Francisco, first vice-president, Dr George E Wilson, Toronto, second vice-president On the same evening the annual College oration on surgery will be delivered by Sir James Walton, of London, England, surgeon to the King's household and attending surgeon at London Hospital

Eminent surgeons of the United States and Canada and foreign countries will present papers dealing with surgical subjects of timely importance at the sessions on Tuesday, Wednesday and Thursday evenings These papers will be discussed by Philadelphia clinicians

At the convocation on Friday evening the new president, Dr Eugene H Pool, will deliver his inaugural address and the Fellowship address will be given by the Honorable Harold M Stephens, Associate Justice of the United States Court of Appeals for the District of Columbia, one time an associate director of the College On this evening the 1936 class of initiates will be received into Fellowship in the College

#### SURGERY OF THE EYE, EAR, NOSE AND THROAT

In addition to the extensive schedule of operative clinics and demonstrations at the hospitals prepared by the subcommittee on ophthalmology and otolaryngology, as presented in the following pages, programs have been prepared for scientific sessions on Tuesday and Thursday evenings in the Rose Garden of the Bellevue-Stratford Hotel at which papers of particular interest to those

surgeons who practice these specialties will be presented by visiting surgeons and discussed by local clinicians The programs for these evening sessions appear in the following pages

Otolaryngologists present at the Clinical Congress are invited to attend a meeting of the Section on Otology of the College of Physicians of Philadelphia at the College building at 19 S 22nd Street on Wednesday evening at 8 30 Dr Wells P Eagleton, of Newark, New Jersey, will deliver an address on 'Certain Aspects of Surgical Meningitis' A subscription dinner will be held at the Rittenhouse Hotel at 6 45

#### FRACTURE SYMPOSIUM

Under the auspices of the Committee on Fractures, a symposium on fractures will be presented in the Rose Garden on Tuesday afternoon, including papers as follows

- FREDERIC W BANCROFT, M D, New York, Chairman,  
Committee on Fractures, presiding  
Fracture of the Upper End of the Femur A New Method  
of Internal Fixation with Adjustable Nails AUSTIN  
T MOORE, M D, Columbia, S C  
Fracture Dislocation of Cervical Vertebrae BYRON SROO-  
KEY, M D, New York  
Fracture of Dorsal and Lumbar Vertebrae J E M  
THOMSON, M D, Lincoln, Neb  
The Treatment of Some Common Fractures about the  
Elbow in Children ALEXANDER MACLENNAN, M B,  
C M, L M, Glasgow, Scotland  
Fractures of the Foot (except the Os Calcis) MELVIN S  
HENDERSON, M D, Rochester, Minn  
Fracture Work of the Association of American Railroad-  
ROSCOE C WEBB, M D, Minneapolis

#### SYMPOSIUM ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

On Wednesday afternoon in the Rose Garden, a symposium on industrial medicine and traumatic surgery will be presented under the auspices of the Committee on Industrial Medicine and Traumatic Surgery Papers will be presented as follows

- FREDERIC A BESLEY, M D, Waukegan, Ill, Chairman  
Committee on Industrial Medicine and Traumatic  
Surgery, presiding  
Insurance Company Relationships and Responsibilities in  
Compensation Insurance A D LAZENBY, M D,  
Baltimore  
Treatment of Abdominal Trauma ARTHUR R METZ,  
M D, Chicago  
The General Management of Injuries JOHN J MOORHEAD,  
M D, New York  
Hernia in Industry JOHN R NILSSON, M D, Omaha, Neb  
Treatment of Old Traumatic Bony Deformities of the Face  
ARCHIBALD H MCINDOE, M B, M S, London, Eng-  
land  
Prophylactic and Active Treatment of Anaerobic and  
Microaerophilic Infections with Zinc Peroxide  
FRANK L MELENEY, M D, New York  
Reports of Surveys M N NEWQUIST, M D, and HAROLD  
EARNHEART, M D, Chicago



at St. Joseph's Hospital by the Medical Record Librarians of Philadelphia.

Thursday will be devoted to a panel round-table discussion of a large number of problems relating to the activities of the several departments.

On Friday the visitors will inspect the hospitals of Philadelphia and vicinity.

#### STATE AND PROVINCIAL COMMITTEES

Members of the State and Provincial Executive Committees will meet with officers of the College at 5 o'clock on Tuesday afternoon in the Oak Room of the Bellevue-Stratford Hotel. A plan for the 1937 series of sectional meetings will be presented, together with suggestions for the desirable grouping of the states and provinces at such meetings in succeeding years. Because of the increasing importance of these meetings, it is urged that all members of these committees be present or represented by their chairman, secretary or counselor.

#### MEETING OF JUDICIARY COMMITTEES

The State and Provincial Judiciary Committees of the American College of Surgeons will meet in the Oak Room of the Bellevue-Stratford Hotel at 11:30 A.M. on Wednesday for the general discussion of the work of these committees and pertinent subjects in which the members of the committees will be interested.

#### ANNUAL MEETING

The annual meeting of the Governors and Fellows of the College will convene in the Rose Garden of the Bellevue-Stratford Hotel at 1:30 o'clock Thursday afternoon. Reports on the activities of the College will be presented by the officers and chairmen of the standing committees, to be followed by the election of officers.

#### MEETING OF NEW FELLOWS

Initiates of the class of 1936 will assemble in the Rose Garden of the Bellevue-Stratford Hotel at 12 noon on Friday for the necessary instructions previous to receiving their Fellowships.

#### RAILWAY RATES

To surgeons living in the western and southwestern states and western provinces of Canada who plan to attend the Clinical Congress, it is suggested they may purchase round-trip tickets with a thirty-day return limit to Chicago or St. Louis on the basis of two cents per mile in each direction for transportation in Pullman cars, not

including the pullman charge. At the above gateway one-way or round-trip tickets to Philadelphia will be purchased is best suits the individual's plans as no reduced rates are in effect on the eastern roads. However, one may purchase in the territory above described, round-trip tickets to Philadelphia with a thirty-day return limit offered by the railroads in those states and provinces on the basis of a combination of the rates authorized by the eastern and western roads. No certificates are required.

In the territory east of Chicago and St. Louis, north of the Ohio and Potomac Rivers, including the New England States, the regular rates of three cents per mile in Pullmans and two cents per mile in coaches will be in effect.

Complete information as to rates, routes and stopover privileges may be obtained from local ticket offices.

#### SPECIAL TRAIN FROM CHICAGO TO PHILADELPHIA

For the convenience of those Fellows living in the central and western states who will attend the Congress in Philadelphia, arrangements have been made with the Pennsylvania Railroad to provide a special train leaving Chicago from the Union Station, Adams, Jackson and Canal Streets, at 2:50 P.M. (C.S.T.) on Sunday, October 18, to arrive in Philadelphia at 8 A.M. (E.S.T.) on Monday. The special train will be composed of air conditioned cars of latest design, including club, compartment, observation, standard sleeping and dining cars. No extra fare will be charged.

Fellows are urged to make their reservations for this special train at the earliest possible date, making application to Mr. G. W. Grant, Passenger Representative of the Pennsylvania Railroad, Room 1027, 33 N. LaSalle Street, Chicago.

#### HEADQUARTERS—TECHNICAL EXHIBITION

Clinical Congress headquarters will be established at the Bellevue-Stratford Hotel, which has unusual facilities for accommodating the Congress. The grand ballroom, Garden, Clover and Red Rooms and other large rooms on the first and second floors and the roof have been reserved for scientific sessions and conferences, registration and clinic ticket bureaus, bulletin boards, executive offices, etc. Thus, the activities of the Congress will be centralized under one roof.

The Technical Exhibition will be located in the ballroom and adjacent large rooms on the second floor. The registration and clinic ticket bureaus together with the registration desk will be centrally located as regards the exhibit rooms, in which will be placed the bulletin boards on which

**SURGERY GYNECOLOGY AND OBSTETRICS**

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544 the daily clinical program will be posted each afternoon. Leading manufacturers of surgical instruments and supplies x ray apparatus operating room lights hospital apparatus and supplies of all kind ligatures dressings pharmaceuticals and publishers of medical books will be represented in this Exhibition.

ADMISSION REGISTRATION

**ADVANCE REGISTRATION**

The hospitals and medical schools of Philadelphia afford accommodations for a large number of visiting surgeons but to insure against over crowding attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the result of a survey of the amphitheatres operating rooms and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected therefore that those surgeons who wish to attend the Congress will register in advance.

Attendance to all clinics and demonstrations will be by the means of special clinics. The means of attendance to the special clinics will be by the means of special clinics.

the hospital for visitors who wish to see their capacity for surgeons who wish to demonstrate that those surgeons who wish to register in advance.

Congress will register in advance and demonstrations will be controlled by means of special clinic tickets which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against any error in using as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic is given.

A registration fee of \$5.00 is required of each surgeon who attends the annual Clinic Congress. The fee is to be paid in advance, which will be used to meet the expenses of the Congress.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his

PHILADELPHIA HOTELS AND THEIR RATES

PHILADELPHIA HOTELS AND THEIR  
In addition to the headquarters hotel the  
Bellvue Stratford there are several first-class  
hotels within short walking distance of head  
quarters providing ample hotel facilities at rea  
sonable rates. It is suggested that reservation  
of hotel accommodations be made at an early  
date. The following hotels are recommended by  
the Committee

[illegible]

person attending the meeting. To each person attending the meeting, the following fees providing the funds will be registered in advance a formal receipt for the expenses of the meeting. Each receipt is to be registered in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his

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**EVENING MEETINGS—SURGERY OF THE EYE, EAR, NOSE AND THROAT**  
 ROSE GARDEN, BELLEVUE STRATFORD HOTEL  
 Tuesday 8:15  
 Neoplasms of the Eye and Orbit  
 WILLIAM L. BENEDICT, M.D.  
 Baltimore, Md.  
 THOMAS E. CARMODY, M.D.  
 Baltimore, Md.

VENING MEETINGS—SURGERY OF THE EYE  
RO E GARDEN BELLEVUE STRATFORD HOTEL  
Tuesday 8:15  
Clinical Considerations of Melanotic Neoplasms of the Eye and Orbit WILLIAM L BENEDICT M D  
Laryngectomy for Cancer of the Larynx EDWARD A LOOPER M D Baltimore  
Pathological Conditions of the Salivary Glands and the Floor of the Mouth THOMAS E CANNODY M D  
Denver  
Results of the Surgical Treatment of Heterotropia Especial Reference to Orthoptic Training CO RAD  
BERENS M D New York  
Thursday 8:15  
Prenatal Medication and Its Relation to the Fetal Ear H MARSHALL TAYLOR M D Jacksonville Fla  
Ophthalmoscopic Findings in Cardiovascular Renal Disease WILLIAM THORN HALL DAVIS M D Wash  
ington D C  
Traumatic Deformities of the Nose and Other Bones of the Face GORDON B NEW M D Rochester Minn  
Surgery and Medicine in the Treatment of Glaucoma WILLIAM H LUECKE M D St Louis

## PROGRAMS FOR EVENING MEETINGS

*Presidential Meeting—Monday, 8 15—Irvine Hall*

- Address of Welcome HENRY P. BROWN, JR., M.D., Philadelphia, Chairman, Committee on Arrangements  
 Introduction of Foreign Guests  
 Address of Retiring President The Function of the American College of Surgeons DONALD C. BALFOUR, M.D., Rochester, Minnesota  
 Inauguration of Officers President, EUGENE H. POOL, M.D., New York, First Vice-President, EMILE HOLMAN, M.D., San Francisco, Second Vice-President, GEORGE E. WILSON, M.D., Toronto  
 The Treatment of Coronary Sclerosis and Angina Pectoris by Grafting a New Blood Supply to the Myocardium CLAUDE S. BECK, M.D., Cleveland  
 Annual Oration on Surgery The Formation and Treatment of Calculi in the Biliary Ducts and Gall Bladder SIR JAMES WALTON, M.S., F.R.C.S., K.C.V.O., London, England

*Tuesday, 8 15—Irvine Hall*

- More Conservatism in Cesarean Section FRANK W. LYNCH, M.D., San Francisco  
 Discussion by P. BROOKE BLAND, M.D., and EDWARD A. SCHUMANN, M.D., Philadelphia  
 Injuries of the Bones and Soft Tissues of the Face VILRAY P. BLAIR, M.D., St. Louis  
 Discussion by ROBERT H. IVY, M.D., and WARREN B. DAVIS, M.D., Philadelphia  
 Treatment of Fractures of the Neck of the Femur by Internal Fixation M. N. SMITH-PETERSEN, M.D., Boston  
 Discussion by JOHN R. MOORE, M.D., and DEFOREST WILLARD, M.D., Philadelphia  
 Fracture Oration The Essential Features of Fractures of the Shoulder GEORGE E. WILSON, M.D., Toronto

*Wednesday, 8 15—Irvine Hall*

- Symposium on Intestinal Obstruction  
 Rationalizing Treatment in Acute Intestinal Obstruction OWEN H. WANGENSTEEN, M.D., Minneapolis  
 Chronic Intestinal Obstruction Due to Lesions of the Large Bowel VERNON C. DAVID, M.D., Chicago  
 Discussion by I. S. RAVDIN, M.D., and THOMAS A. SHALLOW, M.D., Philadelphia  
 The Combined Spleen Clinic Results with Medical and Surgical Therapy in Splenopathies ALLEN O. WHIPPLE, M.D., New York  
 Discussion by ELDRIDGE L. ELLISON, M.D., and EDWARD B. KRUMBHAR, M.D., Philadelphia  
 The Surgical Treatment of Bronchiectasis WILLIAM F. RIENHOFF, JR., M.D., Baltimore  
 Discussion by JOHN B. FLICK, M.D., and WILBUR E. BURNETT, M.D., Philadelphia

*Thursday, 8 15—Irvine Hall*

- The Management of Severe Hyperthyroidism FRANK H. LAHEY, M.D., Boston  
 Discussion by GEORGE P. MULLER, M.D., and W. WAYNE BABCOCK, M.D., Philadelphia  
 Transurethral Surgery, Its Indications, Limitations, and Complications HERMON C. BUMPUS, JR., M.D., Pasadena  
 Discussion by ALEXANDER RANDALL, M.D., and DAVID M. DAVIS, M.D., Philadelphia  
 The Results of Wertheim's Hysterectomy and Radium in the Treatment of Carcinoma of the Cervix WILLIAM FLETCHER SHAW, M.D., Ch.B., F.C.O.G., Manchester, England  
 Discussion by FLOYD C. KEENE, M.D., and BROOKE M. ANSPACH, M.D., Philadelphia  
 Resection of the Rectosigmoid and Upper Rectum for Cancer, with End-to-End Union J. SHELTON HORSLEY, M.D., Richmond  
 Discussion by DAMON B. PFEIFFER, M.D., and WALTER ESTELL LEE, M.D., Philadelphia

*Concocation—Friday, 8 15—Irvine Hall*

- Invocation  
 Presentation of Candidates for Fellowship  
 Conferring of Fellowships The President  
 Conferring of Honorary Fellowships The President  
 President's Inaugural Address Medical Education, Past and Present EUGENE H. POOL, M.D., New York  
 Fellowship Address Medical Practice and the Law HAROLD M. STEPHENS, LL.B., S.J.D., Washington

ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 9 30-10 30—Ro Gu de  
DONALD C B LEO R M D Roche t r Munn pre dang  
Greeting fr m th Int r n tional H p t al Associati  
ARCHIBALD Y O n MB C M Gla-gow Scotland  
Anoth r year f Hosp tal St ndard zat n—the 936 S r  
y GEORGE CRILE M D Cl eland Chairm n  
B d f k g nts.  
Medu al Sc n H o p t al Service and the P t ent BERT  
W CALD ELL M D Cb cag  
Th Art and Sc e of Sug ry REV ALPH ASE M  
The SCH VITALLA S J Ph D St Louia  
The S geon s Int st in H p t al O ganizati n Manag  
m nt and Int M ny I robl ms. FRANK E ADAM  
MD v l r k  
The Educal I A pect of the Mod r n H p t al. JAMES  
S M LES ER M D B r m n gham M  
Org zat n f the M d cal Ser c in an Appo ed H s  
p t al. GEORGE M IERSON M D Ph lad lph  
St H C fe nc —th Key st ne f Sc nt f Ed n n y of  
th H p t al. h v K DAILY M D Houton T xas

Monday 2 00-5 00—Ro G d  
GEORGE W KOSMAK M D New York pr d g  
Sympos m Ade quate Care f th Obstetrical I nt n  
the G al H p t al  
Fr m the Standp t f th Specialized P ctie of  
Ob t l s C ARLE C NO RIS M D d CARL  
BA HMAN M D H lad lphia  
From the Standp t f th C n r l Pract e f Med  
n W LTER BRAD M D T led  
Fr m the Standp t f Anal g s and Anesth ia  
L v L v L C R TILL M D Ch cago  
F m th Standp t f Inurs C re CLAR M  
h o r K J sey C b y  
Fr m th Sta dpo of Administrat n C S WOO S  
MD Cl ind  
The Contr l f M b d i e s a d M tabtes JON V R  
F r g M D M nt al  
Gadu t l n g f r Ob t l s GEORGE W KOSMAK,  
MD w y k  
Th W k f th C m m t M t m I W Hare FRED  
L Ad r M D Ch c g

T d v o 1 00—R s e Gu d  
C v MCK M D Valh lla. n p d g  
What the App d H p t l Mea t h Sta H C m  
mu ty WILLIAM C TEN M D Wax hach  
T xas  
Th C n P t n t a d th C n r al H p t l H L  
S m M D H l d N S  
The M d cal F d th Year H a o n d l o c M D Dan fl  
V est l u a n P f s s i o f d L e n o m P b l m L F  
A s c M D B g f N y  
Does th s k I P t n e d t a r y D e c t k m  
M KAIN S L U  
Med l Soc H l l m f th s k I P t l E  
W r f n l d l y f l P t k m  
Adeq f n r s g C f l P t k m  
D r u M t a g l

T d v o 5 00—P l H p t al  
C m p l t d m t r a t I M r n a l C O t t l l  
l o c h n g d P r o c l e s d u c t d t y N E I S W  
v M D

I tal C e J VERNON ELLSON M D assisted by  
FLU R F C E L SCHWETLE  
Admiss n I P t t and Ass grm t to Acc mmodati  
WALLACE B BRAD ORD M D ROBERT M SHI EN  
P parat n f l l t e f r Labor  
Obser v t e f P t e n t Labor ROSS B WILSON M D  
Ass t e d by ALVIN K t t A V R N  
D i r y Room S t p O t t t i Technique d Pro  
c d u s NORRIS W A A M D  
Car f the P t n t Immed iat ly Postpartum Cliffrord  
B L L L M D  
Car f the I t n t Th r u g h u t Puerper n Whl the  
Hosp tal. k e r A KIMBRO C M D  
f l o w p d L u d k l t s F S t NEY D U E M D  
C a f th Ne born R r i M T n O M D assist d  
by G l v f e ALISON R N

T u d s 8 00-10 p —O k Roo s  
T r o u s C o v A Y J r Ph l d lphia p d n  
I s e r v t n f th l l t a r y H p t al NEWTO L  
D a D D C l m b s O h  
Ext nt f th Tru t s v r al and Legal Obl g t n the  
Care of the P t WILLIAM H WALKER M D  
Ch cago  
H o n Shall the H p t al Trustee Acquire the Necessary  
k w ledge t p r l y D s c h a g e H i s R e s p o l i b i l i t y ?  
L E S t I MATTHEW H l d lphia  
P h l R i t i m th v e w p o n t f the H o p t al  
Trust I G A S C L B O V D I T C H S t n  
Adeq u e t r e p r a t s I E D C C A R T E M D C n t  
D i s c u s s n A L L A N C R G M D T r m g n C n d  
C H A R L E S F A F F R E D W A Y k  
M t n p c t u r e (so nd)—Co o d Hosp tal Car

W d e s d y 9 0-12 00—v l H G d n  
J t S e s s n f A m c C l l g f s r g th the  
A s s o c a t n f A c c d L i l f n th A m m a  
R C B L E R M D M a d s o n W p r e s d g  
Th N e c s s i t y H i s t a n d a r d f D g n o t u e A n c y  
H H p t l C A E B R M D N e w J a  
The S t t e v a l f R e c d s and the P e C l a s s n e a  
C n f i g t e a s o n the Standp t  
Th l f g t M T A E L B M D A t l a t a  
C  
The l f g t J E F F E R O H CLARA M D Ph l  
d l p h a  
Th O t r y n g f g t H C H C B O B E A T T Y M D  
C i m b s O h  
Th C d l o t H K M O I L E M D H l d lph  
The O b s t i a n W B B H A R E R M D H l d  
d l p h  
C n f i d e s n C d c t e d l y D o l d C S W E L L E

C n f i d e s n C d c t e d l y  
H d d a y 10-5 00—S t J p h H p t al  
C m p l t d m t r a t n f m d l r e c r d s w k n th  
h p t l l y  
f l l d l p h a  
A Mod M d f l l d l y  
M B f f l l d l y  
S e c r e t M e d l R e c l y  
W E A E R H l l d l y  
A c t n v e l l u s  
W a y s E L I Z B L I T U

Appraising Medical Records GWENDOLEN C FRANKLIN, Bryn Mawr, Pa  
 Using Medical Records MARGARET CASEY, Philadelphia  
 Composite Character of Medical Records ANNE HOLT-CRAFT, Philadelphia  
 Demonstration—Medical Records Conference Developing a Medical Record Consciousness Throughout the Hospital Conducted by JOSEPH C DOANE, M D, Philadelphia

Thursday, 9 30-12 00—Rose Garden

Panel Round Table Conference—The Care of the Patient  
 A discussion of administrative, professional and economic problems as related to hospital service Conducted by ROBERT JOLLY, Houston, Texas, R C BUERKI, M D, Madison, Wis, and MALCOLM T MACVEACHERN, M D, Chicago  
 Administration LEWIS N CLARK, Philadelphia  
 Government of Hospital FRED B GLERNERD, Allentown, Pa  
 Hospital Auxiliaries MRS WILLIAM J CLOTHIER, Philadelphia  
 Medical Staff Organization S G DAVIDSON, New Haven, Conn  
 Medical Staff Conferences H L SCAMMELL, M D, Halifax, Nova Scotia  
 Medical Records C W WILLIAMSON, M D, Chicago

Clinical Laboratory Service FRANK B LYNCH, JR, M D, Philadelphia  
 X-ray Service W E CHAMBERLAIN, M D, Philadelphia  
 Occupational Therapy HELEN S WILLARD, Philadelphia  
 Oxygen Therapy LEON H COLLINS, JR, M D, Philadelphia

Thursday, 2 00-5 00—North Room

Anesthesia HILDA R SALOMON, R N, Philadelphia  
 Pharmacy Service WILMER KRUSEN, M D, Philadelphia  
 Medical Social Service ALICE F SWIFT, Philadelphia  
 Food Service HELEN C GILSON, Philadelphia  
 Nursing Service C RUTH BOWER, R N, Philadelphia  
 Purchasing JAMES E SHIPLEY, Philadelphia  
 Central Supply Service ELIZABETH BURNS, R N, Philadelphia  
 Housekeeping DORIS L DUNCAN, Camden, N J  
 Laundry HENRY R RUOFF, Philadelphia  
 Engineering ROBERT W GIVEN, Philadelphia  
 Maintenance HARRY W BENJAMIN, Philadelphia  
 Hospital Libraries PERRIE JONES, St Paul  
 Public Relations M H CICHENLAUB, Pittsburgh

Friday

An opportunity will be afforded the hospital delegates to visit Philadelphia hospitals

## COMMITTEE ON ARRANGEMENTS

### Executive Committee

HENRY P BROWN, JR, Chairman

GILSON C ENCEL, Secretary

FRANCIS H ADLER ROBERT H IVY  
 DOROTHY CASE BLECHSCHMIDT H P LEOPOLD  
 JOHN O BOWLER RICHARD H MEAD, JR  
 L K FERGUSON IRANCESCO MOGAVERO  
 BRUCE I FLEMING JOHN R MOORE  
 KARL M HOLSER L A MULLIN

LEWIS C SCHEFFIN

### Hospital Representatives

Abington Hospital—J MONTGOMERY DIVER  
 American Hospital for Diseases of the Stomach—HERBERT R HAWTHORNE  
 American Oncologic Hospital—GEORGE M DORRANCE  
 Broad Street Hospital—LVLFEET H DICKINSON  
 Bryn Mawr Hospital—J STEWART ROBBIN  
 Chestnut Hill Hospital—WILLIAM C SHEPHERD  
 Children's Hospital—IRVING G WILLIAMSON  
 Cooper Hospital—IRVIN I DEIBERT  
 Delaware County Hospital—DEBBY HINTON  
 Fitzcald Mary Hospital—THOMAS J KVAN  
 Frankford Hospital—LOUIS D LSCLEITH  
 Germantown Hospital—WILLIAM B SWARTLEY  
 Graduate Hospital of University of Pennsylvania—WILLIAM BATES, BENJAMIN H SHUSTER, LUTHER C PITH  
 Hildreth Hospital—HEBERT P LEOPOLD, H S  
 Weaver St. HANE O NICKL  
 James Hospital—ROSCOE W HARRA

Jefferson Hospital—EDWARD J KLOPP, LOUIS H CLERF, C L G SHANNON  
 Jewish Hospital—FRANK B BLOCK  
 Kensington Hospital—EDWARD A SCHUMANN  
 Lankenau Hospital—DAMON B PFEIFFER  
 Memorial Hospital—BRUCE L FLEMING  
 Methodist Episcopal Hospital—CALVIN M SMITH  
 Misericordia Hospital—IRANCESCO MOGAVERO  
 Mount Sinai Hospital—BENJAMIN LIPSHITZ  
 Northeastern Hospital—T TURNER THOMAS  
 Pennsylvania Hospital—W ESTELL LEE  
 Philadelphia General Hospital—L K FERGUSON, ROBERT HUNTER  
 Philadelphia Orthopaedic Hospital—DEFOREST P WIL LARD  
 Presbyterian Hospital—JAMES B MASON  
 Protestant Episcopal Hospital—RICHARD H MEADE, JR, OTTO C HIRST, ANDREW KNOW  
 St Agnes Hospital—J W BRANSFIELD  
 St Christopher's Hospital—HARRY L KNOW  
 St Joseph's Hospital—VANCE G BURDEN  
 St Luke's and Children's Hospital—DESIDERIO ROMAN  
 St Mary's Hospital—JAMES A KELLY  
 St Vincent's Hospital—WILLIAM F MORRISON  
 Shriner's Hospital—JOHN R MOORE  
 Stetson Hospital—EDFREDICK A BOTHE  
 Temple University Hospital—W W BABCOCK, MATTHEW S LERNER, W I LILLIE  
 University of Pennsylvania Hospital—J S RAYDIN, HARRY P SCHENCK, THOMAS B HOLLOWAY  
 West Jersey Homeopathic Hospital—L S HALLINGER  
 Wills Hospital—FRANCIS H ADLER  
 Woman's Hospital—MARCARLT SUTLEY  
 Woman's Medical College Hospital—S FAITH FLETTERMAN  
 Women's Homeopathic Hospital—IRANCESCO MOGAVERO





## TEMPLE UNIVERSITY HOSPITAL

## Monday

- CHEVALIER JACKSON, CHEVALIER L. JACKSON and EMILY L. VAN LOON—12 30 Bronchoscopic clinic  
 W. EDWARD CHAMBERLAIN—1 Diseases of the respiratory tract, exhibit in x-ray museum  
 W. EDWARD CHAMBERLAIN and TEMPLE FAY—1 Hydrodynamics of the craniovertebral cavity, working model  
 W. EDWARD CHAMBERLAIN, CHARLES L. BROWN, W. EMORY BURNETT, CHEVALIER L. JACKSON, LOUIS COHEN and ROBERT F. RIDPATH—3 Chest conference  
 LAWRENCE W. SMITH—3 Surgical pathological conference

## Tuesday

- W. EDWARD CHAMBERLAIN—9 Diseases of the cardiovascular system, exhibit in x-ray museum.  
 W. EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydrodynamics of the craniovertebral cavity, working model  
 W. WAYNE BABCOCK—9 General surgical clinic  
 TEMPLE FAY—9 Neurosurgical operations  
 J. HOWARD FRICK—9 General surgical clinic  
 LOUIS COHEN—10 Artificial pneumothorax, ambulant cases  
 J. O. ARNOLD—11 Intradermal test for pregnancy  
 JOHN O. BOWER and staff—12 Surgical research laboratory  
 W. EMORY BURNETT—1 Diseases of the breast  
 JOHN R. MOORE—2 Fractures, deliberate delayed reduction  
 W. HERSEY THOMAS—3 Genito-urinary clinic  
 FRANK W. KONZELMANN—3 Surgical pathological conference  
 TEMPLE FAY—4 Clinical consideration of the epilepsies

## Wednesday

- W. EDWARD CHAMBERLAIN—9 Lncephalography, exhibit in x-ray museum  
 W. EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydrodynamics of the craniovertebral cavity, working model  
 W. WAYNE BABCOCK—9 One stage abdominoperineal proctostomoidectomy with perineal anus  
 J. NORMAN COOMBS—9 General surgical clinic  
 TEMPLE FAY—9 Conference on neurological and neuro-surgical problems, ward rounds  
 CHEVALIER L. JACKSON and WILLIAM A. SWALEM—11 Gastroscopy  
 W. EMORY BURNETT—12 Plastic surgery clinic  
 W. WAYNE BABCOCK and CHARLES L. BROWN—1 Surgical medical conference  
 HARRY Z. HIBSHMAN and staff—3 Proctological operations  
 LAWRENCE W. SMITH—3 Surgical pathological conference  
 TEMPLE FAY—4 Fractures of skull and cerebral trauma  
 BENJAMIN GRUSKIN—1 Intradermal tests for malignancy, pregnancy and tuberculosis

## Thursday

- W. EDWARD CHAMBERLAIN—9 Gastro intestinal and genito-urinary tracts, exhibit in x-ray museum  
 W. EDWARD CHAMBERLAIN and TEMPLE FAY—9 Hydrodynamics of craniovertebral cavity working model  
 W. WAYNE BABCOCK—9 General surgical clinic  
 JOHN FREDOM—9 General surgical clinic  
 TEMPLE FAY—9 Neurosurgical operations, relief of pain

JOHN O. BOWER and staff—11 Surgical research laboratory

- W. EMORY BURNETT—12 Thoracic surgery clinic  
 CHEVALIER JACKSON, CHEVALIER L. JACKSON and EMILY L. VAN LOON—12 30 Bronchoscopic clinic  
 TEMPLE FAY—1 Management of convulsive seizures, epilepsy  
 W. EDWARD CHAMBERLAIN—1 Biplane fluoroscope especially adapted for bronchoscopy  
 J. O. ARNOLD—2 Toremia clinic Demonstration of fluid balance, methods, case records and results  
 JOHN R. MOORE—2 Orthopedic clinic Spine, angle point fusion, shoulder, posterior glenoid repair for luxation, hip, shelf procedure for shallow socket  
 W. HERSEY THOMAS—3 Genito-urinary clinic  
 FRANK W. KONZELMANN—3 Surgical pathological conference  
 TEMPLE FAY—4 Mechanism of headache

## Friday

- W. EDWARD CHAMBERLAIN—9 Bone tumors, exhibit in x-ray museum  
 W. EDWARD CHAMBERLAIN—9 Hydrodynamics of cranio-vertebral cavity, working model  
 W. WAYNE BABCOCK—9 General surgery  
 W. EMORY BURNETT—9 General surgical clinic  
 TEMPLE FAY—9 Brain and cord tumors  
 JESSE O. ARNOLD and staff—11 Obstetrical operations  
 FRANK C. HAMMOND—12 Gynecological clinic  
 CHARLES L. BROWN—1 Cardiac patients as surgical risks  
 CHEVALIER JACKSON and W. WAYNE BABCOCK—2 Diverticulum of the esophagus and hypopharynx, one stage operation  
 LAWRENCE W. SMITH—3 Surgical pathological conference  
 BENJAMIN GRUSKIN—4 Intradermal tests for malignancy, pregnancy and tuberculosis  
 W. EDWARD CHAMBERLAIN, CHARLES L. BROWN, W. EMORY BURNETT, CHEVALIER L. JACKSON, LOUIS COHEN and R. F. RIDPATH—5 Chest conference

## CHESTNUT HILL HOSPITAL

## Tuesday

- FRANKLIN L. PAYNE—9 Gynecological surgery  
 J. F. McCLOSKEY, J. A. LEHMAN and J. M. ELIZAY—10 General surgery  
 ROBERT CADMAN—3 Allergy in surgical diagnosis  
 F. K. ALEXANDER—4 Demonstration of unusual x-ray films

## Wednesday

- WILLIAM B. SWARTLEY, S. DANA WEEDE and STEPHEN WOOLSTON—10 General surgery  
 EDWARD A. SCHUMANN and Z. B. NEWTON—10 30 Obstetrical operations.

## Thursday

- WILLIAM C. SHEEHAN, L. H. HERGESHEIMER and HANS MAY—10 15 General surgery  
 OWEN FORD and H. C. WOOD and W. TOMPKINS—11 Obstetrical clinic and demonstration of cases  
 ALEXANDER RANDALL, FREDERICK SCHOFIELD and FRANK MASSIVISO—2 Genito-urinary surgery  
 JOSEPHUS F. ULLON, EDWARD McCLOSKEY and FRANK M. RAMSEY—3 Symposium on surgical failures

## Friday

- FRANCIS C. GRANT—9 Neurosurgery  
 Staff—10 30 Presentation of cases showing interesting bone lesions in traumatic surgery  
 EDWARD F. CORSON—1 30 Dermatological clinic, skin lesions in surgery



## PHILADELPHIA GENERAL HOSPITAL

*Monday*

H R OWEN—1 30 General surgical operations

*Tuesday*

WILLIAM F MOORE—9 Treatment of bronchiectasis and pulmonary suppuration

HENRY S RUTH and staff—9 Cyclopropane in thoracic surgery

L D ENCLERTH—9 General surgical operations

M P WARMUTH—9 General surgical operations

C A BEHNEY—10 Treatment of gynecological cancer

I S HALLSKY—11 Preparation of intravenous solutions and trays, demonstration

RICHARD MEADE—11 Management of pulmonary tuberculosis by means of artificial pneumothorax and allied operations

EDWARD A SCHUMANN and staff—1 Gynecological clinic

MOSES BEHREND—2 Thoracic surgery

*Wednesday*

HENRY S RUTH and staff—9 Trends in anesthetic methods at Philadelphia General Hospital

P A MCCARTHY and associates—9 General surgery

W WYNF BABCOCK—9 Surgical diagnostic clinic

JOHN BOWER and associates—9 Treatment of spreading peritonitis complicating acute perforative appendicitis, use of convalescent serum and perfringes antitoxin

I S HALLSKY—11 Preparation of intravenous solutions and trays, demonstration

I H CLERF—1 Diagnosis and treatment procedures for intra oral cancer

Staff—1 Symposium on surgical management of diabetics  
EDWARD S DILLON The pre- and postoperative metabolic care of diabetic gangrene E L LITSON Surgery of diabetic gangrene with demonstration of thigh amputation V MURRAY WRIGHT Postoperative surgical complications of diabetic gangrene  
EDWARD S DILLON and W WALLACE DYER Surgical care of diabetic gangrene, motion pictures, ward rounds

W G ELMLER and L D RESCORN—3 Fractured hips

*Thursday*

TEMPLE FAY—9 Neurosurgery

HENRY S RUTH and staff—9 Choice of anesthetic agents and methods

L D ENCLERTH—9 General surgical operations

M P WARMUTH—9 General surgical operations

J C HOWELL—9 Breast cancer

I S HALLSKY—11 Preparation of intravenous solutions and trays, demonstration

JOSEPH MACFARLAND and staff—1 Tumor clinic—General discussion of management, treatment and diagnosis of various types of malignant diseases

W H MACKINNA—2 Urological operations, demonstration of cases

JOHN D REISS—2 Plastic and oral surgery

*Friday*

J C HOWELL—9 Cancer operations

P A MCCARTHY and associates—9 General surgical operations

HENRY S RUTH and staff—9 Pre anesthetic sedation

G MASON ASLEY—9 Incisions for acute appendicitis

W I MORA BURNETT—10 Surgical diseases of the mammary gland

I S HALLSKY—11 Preparation of intravenous solutions and trays, demonstration

B P WARMUTH—2 Technical procedures of x-ray and radium therapy

## HAHNEMANN HOSPITAL

*Tuesday*

ALBERT MUTCH and H D IAFFERTY—9 Obstetrical demonstrations

EARL B CRAIG and staff—9 Surgery and radium in uterine cancer, postoperative results

L T ASHCRAFT, W C HUNSICKER and staff—9 Operative clinic Nephrostomy, prostatectomy, transurethral resection, Caulk-McCarthy punch, demonstration of sacrocaudal block, choice of anesthetics in urological surgery Presentation of cases of renal pathology, pyelographic studies, vesical neoplasms, results of radiation and endovesical therapy presentation of cases, urograms and cystograms, a resume of experimental studies in cortical representation of vesical function, illustrated, demonstration of pathological specimens

A B WEBSTER—9 Fracture clinic

*Wednesday*

JOHN F JAMES, JR and N F PAXSON—9 Obstetrical operations

G A VAN LENTP—2 General surgery, motion picture demonstration

*Thursday*

W M SYLVIS—9 General surgery

EARL B CRAIG and staff—9 Internal pelvic relaxation

THOMAS L DOYLE—9 30 Plastic surgery

JOHN BROOKER—2 Orthopedic clinic

*Friday*

G A VAN LENTP—9 General surgery

LEON CLEMMER and R R GATES—9 Obstetrical clinic

J M SCHOFIELD—2 Diseases of the rectum

*Days to be announced*

WILLIAM KISTLER Gastric pathology, demonstration of the Wolf-Schandler flexible gastroscope

## ST AGNES HOSPITAL

*Monday*

W H HAINES—12 30 Genito-urinary surgery

*Tuesday*

C C MURPHY—9 General surgery

J A MCGILLY and W B HARER—9 Gynecology

H SANGHEISTER W SLESSMAN and Y I YOSHIDA—9 Obstetrical clinic

*Wednesday*

J W BRANSFIELD—9 General surgery

G M DORRANCE—9 Plastic surgery

L AVERETT and W SLESSMAN—9 Gynecology

H SANGHEISTER W B HARER and Y I YOSHIDA—9 Obstetrical clinic

W H HAINES—9 Genito-urinary surgery

*Thursday*

A P KEEGAN—9 General surgery

J A MCGILLY—9 Gynecology

H SANGHEISTER, W B HARER, W SLESSMAN and Y I YOSHIDA—9 Obstetrical clinic

*Friday*

G M DORRANCE and J W BRANSFIELD—9 General surgery

J A MCGILLY and L AVERETT—9 Gynecology

# SURGERY GYNECOLOGY AND OBSTETRICS

## WISCONSIN HOSPITAL

### WOMAN'S HOSPITAL

Munday  
LEA OR BALPH—Ur logical clinic  
Tuesday  
MARGARET STURGIS—Q Stedly inc  
MARGARET STURGIS—ELEE OR BALPH—Helen ANGE  
LUCCI—Gyn col gal p r t o s  
DOROTHY C SE BLESCHMIDT—2 Br st hnd den n  
str l n f cases xry film foll w up stud s  
m thods f diagn ss d scuss on

Wednesday  
MAR ARET SUTLEY—Q G ne l su gical pe t ns  
ALBERTA ELTZ—Q P n tal obstetrical cl c t m s  
p es Q pen d scuss n  
LIDA STE ART COGILL—2 Ob t trical an lgesia  
Staff—2 Dem nst t f k f Social s t D  
partne t n t on t prenatal d t t l c a s  
present t f as s t nte t

Thursday  
DOROTHY CASE BLESCHMIDT—Q Gene al t gal op  
Staff—D m n t ion f w o k of So al Ser e De  
p r m n t n rel at n t p r n al l a d po that l cases  
p sentat on of cases l nter t

Friday  
B M MEINE Pat l gical x h b t  
W RY EA BY Electroce d l g cald monstrat n stud es  
f t val e n cases f u g al sk  
DOROTHY C SE BLESCHMIDT—M t n p t s of  
bd m al su g ry

### AMERICAN ONCOLOGIC HOSPITAL

Tuesday  
GEORGE M D RANCE—C n f nce n neopl t c  
d e se  
GEORGE M D RANCE—2 Ila t c u g r y a d s gery  
f mal en r y

Wednesday  
GEORGE M D RANCE—C o f c n neoplast  
d case

Thursday  
STEPHEN E TRA Y—Q C r t m fut u n neopl t c  
GEORGE M D RANCE—C n f r n  
dise se  
GEORGE M D RANCE—2 Ila t c u g r y a d s gery  
f m l n n y

Friday  
GEORGE M D RANCE—2 C n f c n n p l t  
d case

### PHILADELPHIA ORTHOPEDIC HOSPITAL

Saturday  
DEFOREST P WILLARD—nd t f O teochondr t pe  
t p ed s f r p h f d l t d (sh uld r)  
p ralyt loot tab lizat w th t n d n tr n plant  
som pe t pro edur s f r bon g d f r m t es  
t n d t an plant t w r t n t

Sunday  
A BRUCE GILL—Q Op t as d d m nst t of  
cases

Tuesday  
B R BELTRAN and F J GARVIN—Q Gen als gery  
per t nd dry cl n c  
P M LEE P MOGA ERO and F T McGI 15—Q  
General surgery per t e and dry cl n c  
J A SHARKE—Q Ila n l b t r t cal dms ns and  
th r n f upon b t r t l m taly d m  
b d ty

Wednesday  
J A KELLY and D C GERT—Q G n r al surgery pera  
t e nd dry cl n c  
T J RYAN J F DOUGHERTY d J B CLAFFEY—Q  
Gen r al surgery op r u nd dry cl n c  
P A LOFFELAD—Q V n e n l n c  
A D A RTZ—Q t t p e d c l n  
W J MACMURTER—T em as f p gnancy

Thursday  
C P MULLER P MOGA FRO nd F T McGI 15—Q  
G n l surgery p t e nd dry cl n c  
B R BELTRAN d J J GARVIN—Q Gen l g r y  
per al e nd dry cl n c  
J V MERTZ—Q Red t n f r b t c mplicate n d t  
g p u r p um

Friday  
T J RYAN J F DOUGHERTY n J B CLAFFEY—Q Gen  
al surgery p t e nd dry cl n c  
J A KELLY d D C GERT—Q C n l surgery pe  
t n e nd dry cl n c  
D C GERT—Q l n du t trauma  
A F BOHNE—Q Tum r f t h b l d d e

### GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

Saturday  
JOSEPH C BIRD ALL L F MILLER and F G HARRISON d  
f R O FARMER—2 C n t ur t u g r y d n  
strat f c e t

Sunday  
WILLIAM BATES—Q Ger l gery  
WILLIAM M M HAY and F D A D I M LLEN—  
C t o n y s g r y

Monday  
WILLIAM R NICHOLSON—Q C r l g al u g r y  
W A T E S L F d H L Bock s—Q G n r l  
s g r y  
F r t C C A T—Q N r g r y u r l y s  
J COB W C T L R—Q I t a p l e l p u r l y s

Tuesday  
ROBE R H IVY and L VERN C RTIS—Q Maxill f n al  
W E LEE and C F M R T—Q l y m p h path t n e  
cum

### MEMORIAL HOSPITAL

Wednesday  
EDWARD A SCHMAN d A d i W VOEGELIN Gyn  
c l r c l d  
B C E L L E M  
JAM L L E H M A C n l su gical cl na  
Thyroid s b r y cl

## COOPER HOSPITAL

## Tuesday

- B F BUZBY and DR CARLANDER—9 Orthopedic operations  
 T B LEE and G F WEST—9 Gynecological operations  
 P M MCCRAY, A S ROSS, F W SHAFFER and I L DEIBERT—10 General surgery  
 R S GAMON—10 Fracture clinic, demonstration of cases  
 A B DAVIS, J HARRIS UNDERWOOD, LAWRENCE GLOVER and GEORGE B GERMAN—11 30 Prenatal clinic, demonstration of obstetrical cases  
 A H LIPPINCOTT, D I BINTLEY, JR and R R BETANCOURT—2 Urology

## Wednesday

- P M MCCRAY, A S ROSS, F W SHAFFER and I L DEIBERT—9 General surgery  
 A B DAVIS and staff—9 Obstetrical clinic

## Thursday

- B F BUZBY and DR CARLANDER—9 Orthopedic operations  
 T B LEE and G F WEST—9 Gynecological operations  
 P M MCCRAY and staff—10 General surgery  
 A B DAVIS, J HARRIS UNDERWOOD, LAWRENCE GLOVER and GEORGE B GERMAN—11 30 Prenatal clinic, demonstration of obstetrical cases  
 A B DAVIS—2 Obstetrical operations

## Friday

- Staff—9 General surgery, operative and dry clinic

## PENNSYLVANIA HOSPITAL

## Tuesday

- W L LEE and staff—9 General surgery  
 D L FARLEY, F M McMILLAN and W D STROLD—9 Medical aspects of surgical problems  
 J O BOWLER—2 Surgical pathological conference  
 LEON HERMAN—2 Urological clinic

## Wednesday

- I J KLOPF and staff—9 General surgery  
 G G DUNCAN and R B REGISTER—9 Medical aspects of surgical problems

## Thursday

- W L LEE and staff—9 General surgery  
 D L FARLEY, F M McMILLAN and W D STROLD—9 Medical aspects of surgical problems  
 LEON HERMAN—2 Urological clinic  
 J O BOWLER—2 Surgical pathological conference  
 DR CAMERON—2 Maxillary surgical clinic

## Friday

- I J KLOPF and staff—9 General surgery  
 R B REGISTER and G G DUNCAN—9 Medical aspects of surgical problems

## SHIRNERS' HOSPITAL

## Wednesday

- JOHN R MOORE—9 Congenital hip dislocations, method of reduction employed in children between ages of 4 and 12 x rays, lantern slides and case illustrations  
 Congenital club foot, Hoke method of treatment  
 lantern slides and case illustrations  
 Arthrodesis of the shoulder posterior approach and posteroglenoid repair for posterior shoulder fixation

## ST LUK'S AND CHILDREN'S HOSPITAL

## Tuesday

- D ROMAN, R W LARER, H K ROESSLER and staff—9 Thyroid clinic, general surgical operations  
 E A TAYLOR—9 Anesthesia, demonstrations  
 WARREN C MERCER—9 Gynecological and obstetrical clinic  
 Dry clinic—2  
 F W ROBERTSON The heart and vascular system in relation to abdominal surgery with special reference to gall-bladder surgery  
 D W KRAMER Diseases in metabolism in relation to surgery  
 S L IMVERMAN Recognition of postoperative pulmonary complications

## Wednesday

- L AVFRET and staff—9 Obstetrical and gynecological operations  
 L F MILLIKEN—9 Renal lithiasis in which renal sympathectomy has been done or might be done to prevent recurrence of stones

## Thursday

- A W HAMMER, S HENDOCK and E H DENCH—9 General surgical operations  
 WILLIAM C HUNICKER, SR and staff—9 Genito urinary clinic

## Friday

- J A BROOKE and staff—9 Orthopedic operations and demonstration of cases

## WOMAN'S MEDICAL COLLEGE HOSPITAL

## Tuesday

- J S RODMAN and associates—11 General surgery

## Thursday

- LIDA STEWART COCILL and CONSTANCE VOLK—9 Postnatal clinic  
 HELEN M ANGELUCCI—9 Treatment of trichomonas vaginitis  
 FAITH FETTERMAN—10 Postirradiation lesions of urinary tract  
 LIDA STEWART COCILL—11 Ward talks with demonstration of interesting cases  
 MARGARET STURGIS and ELEANOR BALPH—11 Sterility clinic Tubal insufflation and lipiodol injections  
 ANN GRAY FAYLOR—1 Prenatal clinic  
 CATHERINE MACFARLANE and FAITH FETTERMAN—2 Gynecological operations  
 CATHERINE MACFARLANE and VIRGINIA RHEBA—3 30 Treatment of dysfunctional uterine bleeding

## WOMAN'S HOMEOPATHIC HOSPITAL

## Tuesday

- F L HITCHES—9 Gynecological clinic  
 B I BISCOE—1 Obstetrical clinic  
 J R ROCHSTER—2 Surgical clinic

## Wednesday

- R W LARER—1 Surgical clinic

## Thursday

- LAWRENCE GOLDBACHER—2 Proctology

## Friday

- W C MEACER—9 Gynecological clinic

# SURGERY GYNECOLOGY AND OBSTETRICS

## CHERRY TOWN HOSPITAL

### PROTESTANT LUTHERAN HOSPITAL

T day  
I M BOBIN J W KLE d k l LAYTON-9 G n  
I M BOBIN-2 Dry inc imp tat a frd bte  
gangr ne  
H E KNOX-9 S r g cal n g m nt f i j l u c and  
duoden l i t u c t n a i f nt  
R H MEADE JR-9 J fact rs nlu nong lat lts  
int cal m nt f c t e p r t n o f p p u l e t s  
Lo KY ALLEN-0 X ray tr atm nt f cute surg l  
nfect ons  
E T CROSSAN-10 J Th m n g m nt f acute o i o  
myel t  
JOHN KLOPP and R R LAYTON-1 Th ma g m nt f  
f ctu s about th nle  
RUTH FORD L JOIN- Orthoped c u gery  
ALEX RT MART CCI-4 The manag m nt f per pheral  
ascular d se se

T day  
L B HOD L W B SWARTZ S D W ED R d R S  
ALSTON-03 C n l g c l inc  
DR McLA c l n nd S S WOOL to - J Var cose

H dn day  
JOHN B LO ES nd STANLEY Q WE T-9 U l g l al  
pe i n  
C I MITCHELL W F LEE H F KNOX nd T M DOA  
-93 C n l s u r g i c l n c  
W L LEE nd T M DO s- Th ra s g ry

Tl day  
L B HOGE W B S A T L Y S D W E K A d R S  
ALSTON-30 G tal l cal l c

F day  
C F MITCHELL W L LEE H E KNOX and T M  
DO AS-93 G l u g l l n  
ALEXANDER RANDALL FREDERICK SCH IFLD nd FRA  
I W SSAN SO-1 r t t c t e c t n d e s  
l u t n f p e t t e c t p e t d t n s  
f r ad nd u l t s f n p h p e r y

## NORTHEASTERN HOSPITAL

Tk r d y  
E T CROSSAN H L KNOX nd H H MEADE JR-9  
G n r l s g ry  
F d y  
I M BOBIN J W KLOPP and H H LAYTON-9 G n  
l u g ry

T day  
T T THOM a d J C SC T- Fr ctu l i c  
m t o u p t r d m t r a t n

H d d y  
IRLENDICA F KELLER d ALFRED H DIEBEL-9 G n  
l h l p e r t n  
T T T MAS nd J C SCOTT-1 Fr ct c l n c  
m t p u t d m t r a t n  
J B L L E S and H L D L F I T- C t o r n a r y  
d n c

Tl d y  
T T T MAS a d J C SC T-1 Fr tu c l u  
m t n p t u r d m n t a t n  
FREDERICK KELLER nd ALFRED H DIEBEL-3 Ob-  
s t t a l l d m t a t n f e

F day  
I T T OMAS d J C SC T- Fr t l n c  
m t p t d m n t n

## JEANES HOSPITAL

Tu d y  
HARRY STICKERT-9 J Cossican i n d m sta  
t n and pr nt i n f e s  
L JEMSON-0 Fra tur l n c  
H RST MARK-30 Th al f th l th g l l  
p t n n th t r m nt f u t n e p l a p e  
I E L Y M FR VALIN-1 An expl a t n f p sent  
h g m t l t y n u t p p e n d t s a t h l t t

H d d y  
JAMES A KELL-0 Inj s t m u s c u l s p l n r v e  
ch i c y t e t m y g t t m y  
CHAR F N A S- C l u b y  
L D V nd W G L E O O-3 I r t l l d

Tl d  
S DALE SMITHS-0 D s e f th th y r d g l nd th  
o p t p e d C n l g y and b s t t n  
JANE F CARELL- Fr th r h l p t b y t  
WILLIAM J TH D L M- I m y

T day  
ROSE W T HA C A R S E A WRT nd WILL R  
S H T L W nd L D S H W MROCK  
nd B L W r-9 Appl at f d m l u t  
t n a m f t f c a n m l u t  
f n d D m t t P p e t d t n  
n l m t r l b p y n b g b t t u m t r t  
m t f m f k

## BRYN MAWR HOSPITAL

M d  
C P M T C L L d t a f f- G n l u b r y  
T d  
A BILIN d t f f- G n t l g y

H d d  
W F L R n l t a f f- C n r a l g r y

Tl d y  
J S KODM d t f f- C l g l p e l k s  
LE H RM- C l g l p e l k s

Tl d  
R S W T HAV CL R F C A WIT M W L L A R  
S H T L W nd L D S H W MROCK  
nd B L W r-9 Appl at f d m l u t  
t n a m f t f c a n m l u t  
f n d D m t t P p e t d t n  
n l m t r l b p y n b g b t t u m t r t  
m t f m f k

AMERICAN HOSPITAL FOR DISEASES  
OF THE STOMACH

## Tuesday

- H R HAWTHORNE, W W OAKS and P H NELSE—9  
General surgical operations  
I A MANTZ and S A LGER—9 General surgery  
L F MILLIKEN—2 Surgical treatment of hydronephrosis

## Wednesday

- H R HAWTHORNE, W W OAKS and P H NELSE—9  
General surgical operations  
A A LUCINE—11 General surgical operations

## Thursday

- I A MANTZ and S A LGER—9 General surgery  
T A GREGG—11 Alexander Pfannenstiel operation for  
retroversion, interposition operation

## Friday

- H R HAWTHORNE, W W OAKS and P H NELSE—9  
General surgical operations  
A A LUCINE—11 General surgical operations

## ST MARY'S HOSPITAL

## Tuesday

- JAMES A KELLY—9 Surgical clinic  
HENRY K SELLAUS—9 Surgical clinic  
WILLIAM I MORRISON—10 30 Gynecological clinic  
LJO J WOJCZYNSKI—10 30 Gynecological clinic

## Wednesday

- ARTHUR P KLEGAN—9 Surgical clinic  
JOSEPH TOLAND—9 Gynecological clinic  
EDWARD A WEISS—10 30 Surgical clinic  
J J CANCELLINO—10 30 Surgical clinic

## Thursday

- WILLIAM J RYAN—9 Surgical clinic  
P A MCCARTHY—9 Surgical clinic

## Friday

- HENRY K SELLAUS—9 Surgical clinic  
H A WALSH—9 Surgical clinic  
JOHN G SABOT—10 30 Surgical clinic  
WILLIAM J WALSH JR—10 30 Surgical clinic

## MOUNT SINAI HOSPITAL

## Monday

- M BEHRND—1 15 General surgical operations

## Tuesday

- I I ELIASON—9 General surgical operations  
B FISHBEIN—9 General surgical operations  
M MISCHEAT—1 30 Urological operations

## Wednesday

- C MAZIK—9 Gynecological operations  
M COOPERMAN—9 Orthopedic surgery

## Thursday

- B MANN—9 Gynecological operations  
M MISCHEAT—1 30 Urological surgery

## Friday

- B FISHBEIN—9 General surgical operations  
M BEHRND—1 15 General surgery

## JEWISH HOSPITAL

## Monday

- S RUBINSON—2 Proctology  
I C HAMMOND—4 Gynecology

## Tuesday

- J B LOWNES—9 Urological operations  
M BEHRND—9 General surgery  
W H TELLER—2 General surgery

## Wednesday

- I B BLOCK—9 General surgery  
M BEHRND—2 General surgery

## Thursday

- C J STAMM—9 Gynecology and obstetrics  
I B BLOCK—2 General surgery

## Friday

- R GOLDSMITH—9 General surgery  
A M RECHTMAN—9 Orthopedic surgery  
W H TELLER—2 General surgery

## LANCENAU HOSPITAL

## Monday

- W H MACINNELLY—2 Urological operations

## Tuesday

- D B PFEIFFER, J M DEWEER and EDWARD BORTZ—9  
General surgery, operations and demonstration of cases

## Wednesday

- G P MULLER, G C ENCEL, HANS MAY and JOSEPH  
KFEZEL—9 General surgery, operations and demon-  
strations

## Thursday

- D B PFEIFFER, J M DEWEER and EDWARD BORTZ—9  
General surgery, operations and demonstration of cases

## Friday

- G P MULLER, G C ENCEL, HANS MAY and JOSEPH  
KFEZEL—9 General surgery, operations and demon-  
strations

## ABINGTON HOSPITAL

## Wednesday

- ALEXANDER RANDALL—9 Urological operations  
D B PFEIFFER, C SMYTHE, J W FEVERING, I BOYKIN,  
J M DEWEER, GEORGE M PIERSON and DR LIDAN  
—2 General surgical clinic, operations and demon-  
stration of cases

## Friday

- WILLIAM M SYLVIS, CLARENCE SCHOLLENB, FRED G  
HARLIN WELLS and DR LIDAN—9 General sur-  
gical clinic operations and demonstration of cases  
FRANCIS HUGHES—2 Gynecological clinic

## DELAWARE COUNTY HOSPITAL

## Days to be notified of

- DRURY HINSON and LENA RAYMOND—9 General surgical  
operations  
CLIFFORD B FULL and J V ILLSON—9 Gynecological  
clinic

## FITZGERALD MERCY HOSPITAL

T s d y

J A KELLY and T J RYAN—o Gen l surgery  
W B HAKER—Gynecology

Hed d y

B R BELTRAN and A BURKE—o G l surgery  
J MISSETT—Gyn c l g y

Th d y

J A KELLY and T J RYAN—o Ge l surgery  
J MCGILVER—Gyn c l g y

F d y

B R BELTRAN and A BURKE—o Gen l surgery  
W B HAKER—Gyn c l g y

## CHILDREN'S HOSPITAL

Tuesday

ORVILLE KILGORE—o Acute ppe datus n children  
J E NICHOLSON—O thoped c probl m

Th s d y

W F LEE and FRED ROBBINS—Surgical p bl m in  
chldre

## WEST JERSEY HOMIOPATHIC HOSPITAL

T e d y

H WESLEY JACK and staff—o Gen ral rg cal c l n c

Th d y

H WESLEY JACK and staff—o G enals cal l ic  
C F HADLEY and staff—o Gynecol g cal c l n c

## BROAD STREET HOSPITAL

Wed d y

WARREN C MERCER and staff—o Gyn c l g cal l ic

F s d y

WARREN C MERCER and staff—o Obstetrical c l c

## FRANKFORD HOSPITAL

T s d y

LOUIS D C GLETH—o Surg cal c l n  
WILLIAM E LARKE—o Gyn c l g cal c l n c  
GEORGE C HANNA—nd assoc tes—o Obstetrical cases.

H d d y

RALPH W LARRY and BENJAMIN H CHANDLER—o S r  
g c l c l n c

Th d y

C F NASSAU—o Surg cal c l n c

F d y

LOUIS D C GLETH, BENJAMIN H CHANDLER and RALPH  
W LARRY—o F t ued m t at n

## STLTONSON HOSPITAL

T d y

F A BOTHE, J H MASON and JOHN WOLF—o Genral  
surg ry d sc sc l the thy d

Wed d y

STEPHEN F TRACY—o Gyn c l g cal l ic  
WILLIAM T ELLIS—o G enal gery  
CARL F KOENIG—o Ray lin c

F s d y

STEPHEN L TRACY—o Gyn c l g cal l ic

## KINGSTON HOSPITAL

Th d y

EDWARD A SCHULMAN and WILLIAM L LARKE and W VOEG  
and J V MISSETT and S M FLETCHER and B N T  
and F J KOENIG—o Gyn c l g cal l ic  
nical l c s.

## ST CHRISTOPHER'S HOSPITAL

H d d y

HARRIS L KNOX, JOHN WOLF and L M LEE—o S r g ry  
f chldhood

## IVANS INSTITUTE

H d s d y

R H IVANS and LAWRENCE C CRIS—o Obstetrical



## SURGERY OF THE EYE, EAR, NOSE, AND THROAT

## HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

*Monday*

GEORGE M. COATES and staff—2 Otolaryngological operations  
 HORACE WILLIAMS—2 Otolaryngological operations

*Tuesday*

GABRIEL TUCKER—9 Bronchoscopic clinic  
 GEORGE M. COATES and staff—2 Demonstration of otolaryngological cases and conference  
 I. B. HOLLOWAY and staff—2 Ophthalmological surgery  
 A. G. LEWELL—2 Ophthalmological surgery  
 ALFRED COWAN—2 Ophthalmological surgery  
 WILFRED FRY—2 Ophthalmological surgery  
 P. J. HOLT—2 15 Roentgenology  
 JAMES A. BABBITT—2 30 Otolaryngological clinic  
 HORACE WILLIAMS—3 Otolaryngological clinic

*Wednesday*

OSCAR V. BATSON—10 Otolaryngological clinic demonstration of anatomical and dissection material  
 I. R. CLARK and associates—2 Microscopic demonstration of tissue reactions following surgical injury, etc., as seen in transparent chambers installed in a rabbit's ear  
 GEORGE M. COATES and staff—2 Otolaryngological operations  
 L. H. CAMPBELL—2 Otolaryngological operations

*Thursday*

GABRIEL TUCKER—2 Bronchoscopic clinic  
 I. B. HOLLOWAY and staff—2 Ophthalmological clinic  
 WILFRED FRY—2 Ophthalmological operations and demonstration of cases  
 A. G. LEWELL—2 Ophthalmological operations and demonstration of cases  
 ALFRED COWAN—2 Ophthalmological operations and demonstration of cases  
 GEORGE M. COATES and staff—2 Otolaryngological conference  
 I. P. PRINDLE—2 Neoplasms of paranasal sinuses  
 KATH. M. HOUSLER—2 30 The common cold  
 RICHARD A. KERN—3 Nasal surgery in allergic individuals  
 EDWARD H. CAMPBELL—3 30 Status lymphaticus  
 H. P. SCHENCK—4 Chronic pharyngeal infections

*Friday*

GEORGE M. COATES and staff—2 Otolaryngological operations  
 KATH. M. HOUSLER—2 Otolaryngological operations  
 I. B. HOLLOWAY and staff—2 Ophthalmological surgery and demonstration of cases  
 WILFRED FRY—2 Ophthalmological clinic  
 ALFRED COWAN—2 Ophthalmological clinic  
 A. G. LEWELL—2 Ophthalmological clinic

## WEST JERSEY HOMOOPATHIC HOSPITAL

*Monday*

A. M. K. MALDEN and associate—2 Ophthalmological clinic

*Wednesday*

I. S. HALLINGER and staff—2 Otolaryngological clinic

## WILLS HOSPITAL

*Monday*

FRANK C. PARKER—2 Operations  
 THOMAS A. O'BRIEN—2 Dry clinic

*Tuesday*

Staff—9 Dry clinic  
 ALFRED COWAN Sht lamp technique  
 MILTON J. GRISCOM Unusual external diseases  
 EDMUND B. SPAETH Plastic surgery of the eyelids  
 LEIGHTON F. APPLEMAN Testing for phorias  
 WALTER I. LILLIE The localizing value of visual field changes  
 FRANCIS H. ADLER—1 Operations

*Wednesday*

Staff—9 Dry clinic  
 ALFRED COWAN Sht lamp technique  
 MILTON J. GRISCOM Unusual external diseases  
 EDMUND B. SPAETH Plastic surgery of the eyelids  
 LEIGHTON F. APPLEMAN Testing for phorias  
 CHARLES R. HEED Fundus diagnosis  
 WALTER I. LILLIE The localizing value of visual field changes  
 THOMAS A. O'BRIEN—2 Dry clinic  
 FRANK C. PARKER—4 Operations

*Thursday*

I. H. ADLER—1 Operations

*Friday*

THOMAS A. O'BRIEN—2 Operations  
 F. C. PARKER—2 30 Operations

## GRADUATE HOSPITAL OF UNIVERSITY OF PENNSYLVANIA

*Monday*

RALPH BUTLER WILLIAM C. WOOD, HARRY A. SCHATZ and staff—2 Rhinological clinic, operations and demonstration of cases  
 WALTER ROBERTS, HENRY DINTFESS and staff—2 Otolaryngological clinic, operations and motion picture demonstration

*Tuesday*

GEORGE M. COATES, BENJAMIN H. SHUSTER, M. VALENTINE MILLER and staff—2 Otolaryngological clinic, operations and demonstration of cases  
 GEORGE M. COATES, SAMUEL R. SKILLERN, JR., HERMAN B. COHEN and ROMEO A. LONGO—2 Rhinological clinic, operations and demonstration of cases  
 BENJAMIN H. SHUSTER, HERMAN B. SLOVIN, MARTIN STINFELT and ALBERT I. MORICONE—2 Neuro-otological examinations

*Wednesday*

GEORGE B. WOOD, SAMUEL COHEN, PHILIP STOLT, FRANK O. HINDRICKSON, GEORGE I. JOHNSON and staff—2 Otolaryngological clinic nasal plastic surgery  
 LUTHER C. PETERS—2 30 Ophthalmological operations

## CHILDREN'S HOSPITAL

*Days to be arranged*

A. LEVILL Ophthalmological surgery

## TEMPLE UNIVERSITY HOSPITAL

Monday

CHEVALIER JACOBSON CHIEF CLERK L. JACKSON and EMILY  
L. V. LOO — 2 0 B n h s c p c l n c  
ROBERT F. KIDPATH — 2 R d c al f r o t a l p e a t n  
WALTER I. LILLIE a d staff — 3 Ophthalmology

Tuesday

ROBERT F. KIDPATH — 2 Sph no d p o b l m  
CH. VALER JACKSON CHIEF CLERK L. JACKSON a d W  
WALTER B. BECK — Ca cer of th l r y n x  
MATTHEW S. LESER — Otol g cal p a t i m d e r  
c e c p t f e c s

Wednesday

MATTHEW S. LESER — l a t e m e t a n d m t  
l j g u l r i g a t i o n i n t m o c a p l n t s t h  
i d u t r a t n s  
ROBERT F. KIDPATH — 2 V i e p r o d u c t n

Thursday

CHRYA IER JACOBSON CHIEF CLERK L. JACKSON and EMILY  
L. V. LOO — 3 0 B n h s c p c h n i  
MATTHEW S. LESER and E. M. CHELL — O t l g c l  
p e a t i s  
ROBERT F. KIDPATH — 2 C a l d H L p r a t o  
MATTHEW S. LESER — 3 0 t o l o l  
WALTER I. LILLIE — 3 Ophthalmology

Friday

SAMUEL B. C. L. N. AY I R L. M. ERS. SIMON B. L.  
FRANK L. F. L. V. I E d BIRCH RACHIS —  
D m o s t a t n f a d m t e r n d l t d a g n s t c  
p o u n t f l a t a l u e f t n g f k  
ROBERT I. KIDPATH — N l l  
MATTHEW S. LESER a d l d D M i C H E L L — 2 3 0 O t  
l l c l c

## JEFFERSON HOSPITAL

Monday

LOUIS H. C. E. — 2 E a c l c

Tuesday

H. H. LOO — 2 N s e a d t h t p t a n  
LOUIS H. C. E. — N s e n d t h t c l u s e  
CHAS. L. L. C. S. H. O. N. — 2 E p t

Wednesday

A. H. T. SMITH — 0 N s e n d t h a t p r a t  
LOUIS H. C. E. — O t l g a l c l n c

Thursday

A. J. W. L. — 0 N s e n d t h a t p t s  
LOUIS H. C. E. — N s e n d t h t d l n c h o s e p c  
l

Friday

LOUIS H. C. E. — F c l n  
CHAS. L. L. C. S. H. O. N. — 4 L v f t

## PENNSYLVANIA HOSPITAL

Saturday

CLINTON C. E. — d t f — (O t l r y n g l g a l p e t  
d d m n t t n f s c

Sunday

C. R. I. C. G. S. — d t a f — O t l r y n g l g a l p e r a t n  
n d m t t n f c s c

## PHILADELPHIA GENERAL HOSPITAL

Monday

HERBERT M. CODDARD — O t l r y n g l g a l l c

Tuesday

BE JAMIN H. SHILSTER — L r y n g e a l t u b e c l

Wednesday

LOUIS H. CLERK — 2 M a g m n t f e c i n m a l t h e  
l y n x

Thursday

ROBERT J. HUNTER — O t o l a r y g l o g e l l

Friday

DAVID N. H. — O t o l a r y g l o g e l c n c

## ST JOSEPH'S HOSPITAL

Monday

ARTHUR WAGLE — O t l r y n g l g y

Tuesday

CORNELIUS T. MCCARTHY — O t o l r y g l g y

Wednesday

ROBERT L. DICKSON — 2 O t l r y g l o

Thursday

THOMAS A. OBER — O p h t h l m l g y

Friday

THOMAS F. GOET — O t l r y g l g y

CHARLES JOYE — 3 O p h t h l m l g y

## HAINEMAN HOSPITAL

Saturday

H. S. WEAVER — d t f — O t l r y n g l g c l l c

Sunday

H. S. WEAVER — d t a f — O t l r y l g c a l l n c

Monday

H. S. WEAVER — d t a f — O t l r y l g l l

Tuesday

FRANK O. GL — 3 O p h t h l m l g c l p a t

AFRICAN HOSPITAL FOR DISEASES  
OF THE STOMACH

Wednesday

G. H. DEAN — 3 E p e t

Thursday

J. C. H. — N s e n d t h t p e t

Friday

R. J. H. — N s e n d t h t p t

## BRYAN MAWR HOSPITAL

Saturday

Staff — O t o l r y n l g

Sunday

Staff — O p h t h l m l g y

## MOUNT SINAI HOSPITAL

*Monday*

M ERSNER—2 30 Otolaryngological clinic

*Tuesday*

D HUSIK—2 Otolaryngological clinic

*Wednesday*

G TUCKER—9 Bronchoscopic clinic

M WINSTON—2 Otolaryngological clinic

B I BAER—5 Eye operations

*Thursday*

M ERSNER—2 30 Otolaryngological clinic

A BARLOW—4 Eye operations

*Friday*

D HUSIK—2 Otolaryngological clinic

## PROTESTANT EPISCOPAL HOSPITAL

*Monday*

J A BERTOLET and staff—2 Nose, throat and sinus surgery

K A KASPER—4 Anatomy of the nasal accessory sinuses

*Tuesday*

NELSON M BRINKERHOFF—2 Ophthalmological clinic

*Thursday*

OTTO C HIRST and staff—2 Nose, throat and sinus surgery, relocation of the triangular cartilage

NELSON M BRINKERHOFF—2 Ophthalmological clinic

*Days to be announced*

ANDREW KNOX Ophthalmological clinic

## COOPER HOSPITAL

*Monday*

J S SHURMAN and staff—2 Lye surgery

*Tuesday*

O R KLINE—2 Postoperative acute and chronic frontal sinusitis

*Wednesday*

O R KLINE, I B HIRST and J P BRENNAN—2 Nose and throat surgery

*Thursday*

A M ILWILL—2 Otolaryngological operations

## SILVENS HOSPITAL

*Monday*

G I J KELLY—4 Eye clinic

*Tuesday*

I D SULLIVAN and A A S GIOVEDANO—12 30 Nose and throat clinic

*Thursday*

I D SULLIVAN and A A S GIOVEDANO—12 30 Nose and throat clinic

*Friday*

G I J KELLY—12 30 Eye clinic

## ST LUKE'S AND CHILDREN'S HOSPITAL

*Monday*

J W POST and FRANK W BURGE—2 Clinical and x-ray study of bronchography

*Wednesday*

GEORGE MACKENZIE—2 Nose and throat operations

PHILIP S STOLT—2 Tonsillectomy by eversion method, modified radical mastoid

*Thursday*

S H BROWN, F C PETERS and staff—2 Ophthalmological operations

*Friday*

S A BRUMM and staff—2 Nose and throat operations

## FITZGERALD MERCY HOSPITAL

*Monday*

C T MCCARTHY—2 Otolaryngology

*Tuesday*

H S BUSLER—2 Otolaryngology

*Wednesday*

J LOFTUS—2 Otolaryngology

*Thursday*

C T MCCARTHY—2 Otolaryngology

*Friday*

H S BUSLER—2 Otolaryngology

## CHESTNUT HILL HOSPITAL

*Tuesday*

JOHN B DAVIES and GEORGE F FARIS—2 Otolaryngological operations

*Wednesday*

B D PARISH and F FRAGANZA—2 Otolaryngological surgery

*Thursday*

CARL WILLIAMS—1 30 Ophthalmological surgery

*Friday*

CHEVALIER JACKSON—9 30 Bronchoscopy

## ABINGTON HOSPITAL

WALTER HUGHSON and staff Demonstration in Otolological Research Laboratory Apparatus and general equipment required for conducting experimental investigation of the physiology of the ear, experiment will be done to demonstrate the technical approach to the study of both air and bone conduction The clinical implication of experimental findings and the routine examination of deafened individuals will be explained This examination includes standard and ometer tests, bone conduction audiograms and estimation of the degrees of fatigue produced in the pathologic ear by exposure to tones of high intensity

*Wednesday*

FRED W SMITH—2 Otolaryngological clinic

## METHODIST EPISCOPAL HOSPITAL

*Tuesday*

WALTER ROBERTS and staff—2 Otolaryngological operations

## ST MARY'S HOSPITAL

*T d y*

R T M DO ELLY—2 Ophthalmology

*H d d y*

FRA. A J MURPHY—2 Ophthalmology

*Th d y*

WILLIAM I CRADY—030 Otolaryngology

I J MURPHY—103 Otolaryngology

R T M DO ELLY—2 Ophthalmology

*F d y*

FRA. A J MURPHY—2 Ophthalmology

## PRESBYTERIAN HOSPITAL

*M nd y*

C M COATES W I CARL—Jt fl—Otolaryngology

H M LARSON—J THORNTON—nd fl—1 Ophthalmological practice

*H d e d*

G M COATES W L CARL—nd fl—2 Otolaryngology

*F d y*

G M COATES W I CARL—nd fl—2 Otolaryngology

## JEFFERSON MEDICAL COLLEGE

*Th sd y*J P RSO SCHAEFF—Dm t t the D J  
High Institute of Anatomy Cell t d th  
clinical n t my f th p a sal use

## UNIVERSITY OF PENNSYLVANIA

*H d sd*OSCAR A BARSO—Dm t t the Medical  
Laboratory Lect dem n t t d p se tat n  
f t lary glg l at m l m t l

## MEMORIAL HOSPITAL

*D v t b d*

H RACE WILLIAMS Otolaryngology

VALERIE M MILLER—Laryngology

## WOMEN'S HOMEOPATHIC HOSPITAL

*F d y*

C V FRIS—Ophthalmology

J R CRYLL—Otolaryngology

## STITSON HOSPITAL

*M nd*

C H GIMES—Otolaryngology

## MISERICORDIA HOSPITAL

*M nd y*J K B L A—Nasal hyperesthesia treatment by  
i c t u*H d d y*

G BRILL THER—2 B choscopy c l c

*Th d y*C T M CARTER—2 Th e cases p l l t r a l n s t m  
bo s w th c t r y*F nd y*

J A LORRIS—2 Mast d c t m y

## WOMAN'S HOSPITAL

*M d y*EMILY L VALE—2 B choscopy l c R t  
b choscopy n t r t m t f th m a l cases, sh  
f ay f l m s d c s e d s e s o

H. R. ITA T—2 Otolaryngological practice

*Th d v*MARY B C A A—2 S g r y c l t h y t m a l f  
c a t c t

## JEWISH HOSPITAL

*M nd y*

A B AV—Ophthalmology l c l c

*Th d y*H M GODDARD—2 S b m c s e c t i t h a d  
t c c t t*F nd y*

A BRA—Ophthalmology l c l

## WOMAN'S MEDICAL COLLEGE HOSPITAL

*H d e d y*C E MERJON—2 A d EMILY L V LOON—2 B d  
ch s c p c l

## LANEVAU HOSPITAL

*D v t b d*

WILLIAM T SHUMWAY—Ophthalmology l c l

## BROAD STREET HOSPITAL

*Th d v*C J I L V—2 C F H I I S—2 V s e d t h r o t  
c l

## FRANKFORD HOSPITAL

*Th d y*

FRA. E. L. B. V. d s o t—Otolaryngology

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## INTRINSIC FACTORS ALTERING THE ABSORPTION OF CATGUT

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THE purpose of this paper is to draw the attention of the surgical profession to some intrinsic factors in catgut, not previously stressed, which may alter its absorption. By intrinsic factors is meant structural defects and physical alterations in the material, the local and general effect of various chemicals incorporated in it and reactions which may be attributed to the specific protein of this suture material itself.

### IMPROVEMENT OF METHOD OF DIGESTION DETERMINATION

In making determinations on the digestion time of catgut *in vitro* by a method previously described (6), it was noticed that occasionally a suture digested in very much less time than usual for that particular size and brand. This was at first thought to be due to imperfections in the mechanism and a careful revision of the method was made. A new apparatus was designed, shown in Figure 1, in which it is believed all the variables have been eliminated. A hook was used in a glass centrifuge tube avoiding the use of a slip-knot on a glass rod, exactly 10 centimeters of catgut are measured on the tube, the beam is carefully balanced on a frictionless knife edge, and the clips are accurately counterbalanced by the switch trip. The switches themselves are mercury and therefore are frictionless. It was found by Stonchill that bacterial growth may be eliminated by the addition of 2 cubic

centimeters of a 1:1000 solution of merthiolate in each 10 cubic centimeters of a 2 per cent trypsin digestion media. It has also been found useful to put 2 cubic centimeters of sterile alcohol on top of the media to seal it from air contact.

### DEFECTS IN STRUCTURE

With this improved method, another series of digestion determinations were made on the various sizes of catgut of three manufacturers, as shown in Table I. This shows the average digestion rate of plain and chromic, boilable and non-boilable, catgut. Several determinations were made in each instance, but it was found that occasionally a strand still digested in too short a time for the average of that variety. For instance, a strand manufactured by A digested in  $13\frac{1}{2}$  hours and the average digestion time for this type of gut was over 200 hours which was confirmed by numerous determinations. Another instance was the digestion of a strand in  $5\frac{1}{4}$  hours when the average time was 14 hours. Feeling that all possible sources of error had been eliminated from the apparatus, a careful microscopical examination of the catgut itself was made with the hope that some explanation for these discrepancies might be made.

This led to some interesting observations. The most consistent was the presence of defects where the strands were bent to be put in the tubes as shown in Figure 2. Some

frayed ends may be seen which certainly would allow the digestion fluid to enter and digestion would be rapid at this point. In other rather startling discovery was the presence of large foreign bodies twisted in the gut (Figs 3 and 4). This appears to be amorphous material of some kind but the actual amount is too small to analyze. The most serious defects are obvious flaws. They do not occur very regularly but the one shown in Figure 5 leaves only about half the normal width of the strand. It is believed that these occur when a ribbon is spliced.

Although not entirely consistent the table also shows that the larger sizes do not necessarily last longer than the smaller sizes. The explanation of this may be that the digestive media penetrates between the ribbons and digests each separately. In chromic gut the chromicizing may be on the outer layer only and when this is penetrated digestion is rapid while in the smaller size the chromicizing extends through the entire strand.

#### COMPARISON OF BOILABLE AND NON BOILABLE CATGUT

It is thought that other alterations in the digestion time may be related to the amount of water in the suture material. In order to make catgut boilable it must be completely dehydrated and supplied in a medium usually xylol containing no water as the boiling of course would hydrolyze the protein and destroy its properties. Consequently boilable catgut is stiff wiry and inflexible. When this is put in the tissues it absorbs considerable fluid. To avoid this difficulty manufacturers have produced a non boilable product which is prepared basically in the same manner as the boilable but put in a medium of 95 per cent alcohol and 5 per cent water. A smooth flexible gut is thus produced which resists digestion longer in most instances than the boilable gut as is also shown in the table. This is attributed to the fact that more of the digestive media is absorbed by the dehydrated catgut than the one containing some water. The change in the size of the strand and its texture may be observed by immersing short sections of gut in dilute base ( $\text{NaOH}$  1:100). The results of this are shown in Figure 6.

The top row shows sections of non boilable size 1 plain and chromic size 1 of a foreign manufacturer and size 1 boilable plain and chromic. The second row shows sections of the same gut after 15 minutes exposure to the dilute base the third after a half hour and the fourth after an hour. The marked swelling fraying and change in texture of the boilable gut as compared with the non boilable will be at once appreciated. It is believed that the lack of change of the foreign catgut is due to a chemical fixation to be discussed under that heading. The difference in the physical properties of boilable and non boilable catgut may be observed also in sutures placed in living tissue. Figure 7 shows the appearance of non boilable size 1 plain and chromic and boilable size 1 plain and chromic which have been allowed to remain a week in the musculature of a rabbit's back. It will be seen that the plain boilable is untied and partially digested the chromic slightly frayed while there has been little or no effect on the non boilable.

It is believed therefore that non boilable catgut may be depended upon to remain in the tissues longer than the boilable and its original property of flexibility tends to make the knots more secure and increases its efficiency in the other phases of operative technique. The only advantage of boilable catgut is that the outside of the tube may be boiled but with the improvement in antiseptic agents one may feel equally secure of the sterility of the outside of the glass tube as it is one of the easiest materials to sterilize with our modern germicidal solutions.

#### EFFECTS OF CHEMICALS

When one considers the effect of chemicals on the absorption of catgut the most complex problems present themselves. One of the difficulties is that the manufacturers often will not divulge the secrets of their process and it is only by testing for numerous chemicals (2) that one may learn what may be present in the gut.

As pointed out before the most resistant catgut to digestion has been produced in foreign countries. Smith has stated that he prefers to harden the gut with formalin and

TABLE I—AVERAGE DIGESTION RATE OF CATGUT *IN VITRO*

Manufacturer	Size	Plain		*Chromic	
		Boilable	Non boilable	Boilable	Non boilable
		Hours	Hours	Hours	Hours
A	000	19½	23	207½	9½
B	000	14	17½	9¼	75
C	000	4½	5½	31½	24
A	00	14	10	46¾	166½
B	00	8½	24¾	11¼	59¼
C	00	4¼	8½	25¼	25¼
A	0	6½	18¾	6½	54¾
B	0	14½	10¾	51½	4¾
C	0	4½	7¾	33¾	12
A	1	22	17½	20	13½
B	1	11	10	33	70½
C	1	12	7½	27¾	12
A	2	14	15½	33	45¾
B	2	5¼	11¾	23¾	9¼
C	2	8	3¾	1¾	11

\*In each instance the chromic catgut was designated as medium hard or 20 day variety

it is believed that a great deal of foreign catgut has been preserved in this way during some stage of its preparation. Although it cannot be detected in all instances, it is probable that the formalin enters into chemical union with the protein when it fixes it and the surplus is removed during the subsequent processes. This foreign catgut was also buried in the muscle of rabbits' backs and found to be unchanged after 3 weeks. In Germany Haefen has made a similar but more extensive study of the absorption of iodized catgut buried in the muscle and subcutaneous tissue in the backs of animals. These were removed at various intervals and microscopic sections were made. The catgut was said to lie in canals, the walls of which showed aseptic necrosis. It was also observed that absorption took place very slowly and only after 4 months could one be sure that no more catgut remained in the tissues. He therefore points out how unnecessary it is to use metallic salts to prolong the absorption time further.

In these observations on the reaction about the suture, the aseptic necrosis of the wall of the suture canal may be attributed to the

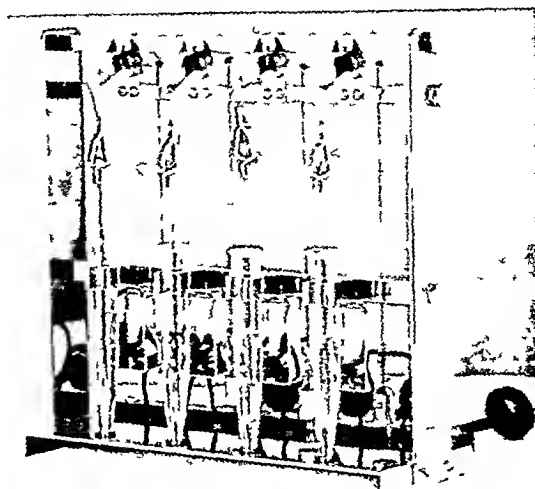


Fig. 1 Apparatus used in experiments

liberation of the iodine. Schulze and Henning have found that the iodine content of iodized gut is from 3 to 6 per cent. Of this, 60 per cent is free iodine, 30 per cent is in the acid form, while only 10 per cent is combined with the albumin. Reil has studied the chemical reactions which take place about catgut. He says that the complicated proteins of the muscle tissue are broken down into polypeptides, diocypiperazene, cystin, and glyocol. These are further broken down into ketones, carbondioxide, and amines, and the metals and halogens which may be present, being of positive ionic reactions, unite with the negatively charged tissue and cause a reaction.

It will be noted in Table I, that some of the boilable catgut (manufacturer A—chromic 000) had a markedly delayed digestion time. This was labeled "germicidal catgut" and mercury was found to be present in it. Two quantitative analyses revealed an average of 5.05 milligrams in 1 gram of plain catgut equivalent to approximately two and two-thirds tubes of size No. 2. It is thought that the prolonged digestion time may be explained by an alteration of the enzyme action by the mercury.

The chemical, which is present in greatest concentration in the chromicized catgut, is of course the chromic acid. What action this has on tissues when it is liberated in small



Fig 2 Best transverse not visible  
Figs 3 and 4 In cross section not visible

Fig 5 Flattened to half the  
normal width of the transverse

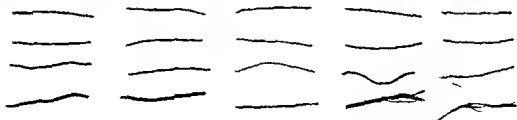


Fig 6 Chromic acid reaction on the skin

amounts is interesting to contemplate. In larger amounts it has been known for many years to be highly toxic (9) and offers a serious problem to workers who are exposed to it in industry (16). In addition to its local toxic and irritative effect (3) a considerably greater reaction may be expected if the individual is

sensitive to the metal, a case of which was reported by Smith. As shown by Table III a series of cases were tested for chrome sensitivity by intradermal tests of a 1:10,000 solution of chromic acid in saline. One patient gave a particularly marked reaction, a photograph of which may be seen in Figure 8.



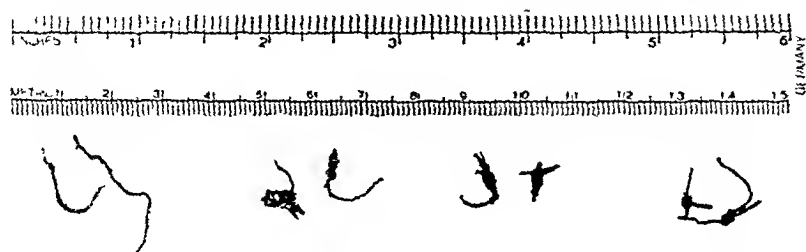


Fig 7 Changes in boilable and non boilable sutures after being placed in living tissue

#### CATGUT ALLERGY

When one considers the question of sensitivity to catgut, the problems are even greater than with the toxic effect of chemicals. Babcock has raised this question and tells how it might be avoided by the use of steel alloy wire. The tests were made by Pratt and Small and consisted of burying short pieces of catgut in the sterilized skin of 120 patients. A reaction consisted of redness, flare, and wheal and was observed in every patient but varied in degree of intensity. In view of the fact that bacteria were present in the hair follicles and sweat glands and in view of the fact that absorbing suture material is an excellent culture media, and also because every patient exhibited a reaction, it is a question whether or not this test was a true demonstration of catgut allergy. Tripp has described a case of a patient convalescing from a second operation, who suffered with severe asthma while it was assumed she was absorbing the catgut to which she was sensitized by her first operation. Unfortunately, her sensitivity to catgut was not demonstrated by a skin test.

Experimentally, Marchesani sensitized 5 series of guinea pigs with sheep serum, catgut extract, and catgut itself introduced intraperitoneally. After 14 to 40 days they were tested by intracardiac injections of catgut extract and sheep serum. In about one-third he was able to demonstrate sensitivity by general reactions. He also buried catgut in the tissue of normal and sensitized animals and found that in the latter there was hyperemia, edema, and a wide leucocytic wall, and even occasionally local necrosis.

Gratia and Gilson sensitized three series of guinea pigs, one to horse serum, one to sheep

serum, and one to both sera. Catgut, itself, was introduced into the peritoneal cavity, and this caused marked local reaction, consisting of edema and hemorrhage and in some instances the exudate caused intestinal obstruction. The reaction was most marked in the animals sensitized with sheep serum and slight reactions were present in those sensitized with horse serum. It was believed that this manifestation of sensitivity may be responsible for some unsuspected causes of post-operative complications.

Moriconi was unable to produce evidence of allergy in two series of rabbits as determined by the demonstration of specific antibodies in



Fig 8 Reaction to chromic acid intradermal test



Fig 9



Fig 10

Fig 9 Guinea pig No 553 Dis-  
 position of wound after suturing  
 with catgut  
 Fig 10 Guinea pig No 555 Dis-  
 position of wound after suturing  
 with catgut  
 Fig 11 Guinea pig No 554 Dis-  
 position of wound after suturing  
 with catgut



Fig 11

the blood general or local reactions. He attributed this to a loss of specificity of the protein by the breaking down of the albumin into its component parts by the digestive elements of the body before going into the circulation. It is to be noted however that he was working with rabbits which are rather difficult to sensitize and it is probable that he was using catgut which was hardened by fixatives. As has been pointed out catgut that has been put through this process absorbs very slowly.

With these experiments in mind it was thought that it would be of considerable interest to determine whether or not there would be an alteration in wound healing in sensitized animals sutured with catgut and to see whether or not any of the cases of disruption which have occurred in the hospital could be explained on this basis.

Working with Dr Beatrice Kesten of the Department of Dermatology a preliminary group of 19 guinea pigs were sensitized to plain and chromic catgut. This was done with intraperitoneal injections of a colloidal suspension by burying catgut itself subcutaneously and by closing abdominal laparotomies with catgut. In addition one was sensitized by intracardiac injection and another by repeated intradermal injections. Intradermal injections of approximately 0.1 cubic centimeter of extract were used to determine sensitivity. This extract was prepared by grinding the gut to a powder sterilizing in an oven as described by Rappaport and extracting by allowing 5 grams to be exposed to 100 cubic centimeters one hundredth normal sodium hypochlorite in an agitator for 24 hours. This was diluted with saline (1:10 ccm) giving a final concentration of 0.13 milligram per 100 cubic

centimeters of the plain and 0.14 milligram of the chromic as determined by the micro-Kjeldahl method. Laparotomies were then performed on the animals and sewed with through-and-through bolt sutures of plain or chromic catgut.

The results of wound healing are shown in Table II. It will be seen that 6 of the 10 disrupted, 3 being sewed with plain and 3 with chromic, one of each being sensitized to the other type of gut. None of the six controls disrupted but one had slight redness and inflammation about the wound which subsided and the wound appeared normal in 2 days. The appearance of the disruption of a wound sutured with plain catgut is shown in Figure 9. A wound disruption sutured with chromic catgut is shown in Figure 10 while the appearance of a wound which healed normally sutured with plain catgut is shown in Figure 11. This preliminary group of animals was relatively small for a scientific experiment and the experiment is being repeated on a larger group at the present time, but it has shown that disruptions may be produced in sensitized animals.

In an attempt to estimate the practical application of this principle, a thorough résumé was made of the 56 cases of wound disruption which occurred in the Presbyterian Hospital during the past 5 years. The various factors which may have been related to this serious complication were listed under the headings of sex, age, type of operation, method of suturing and suture material, drainage, general condition of the patient, presence of debilitating disease, the history of allergy, previous operations, complications during immediate postoperative period, time of removal of sutures, day of disruption, appearance of the wound at disruption, its repair, and the final result.

Although a wealth of information was gained by this review, only a few significant facts relate to our study. In every case in which the appearance of the suture material was described at the time of disruption, it was observed that the catgut was completely digested or only a few partially digested fragments remained. It was also interesting to note that of the entire group of 56 cases, 4

TABLE II—REACTION OF GUINEA PIGS SENSITIZED TO PLAIN AND CHROMIC CATGUT

Pk. No.	Route of sensitization	Skin reaction	Laparotomy	Wound healing
551	Subcutaneous suture (Ch)	+	Plain	Normal
551	Subcutaneous suture (Ch)	+	Chromic	Normal
55	Intradermal injection (Pl)	+	Plain	Normal
55	Intracardiac injection (Pl)	—	Plain	Normal
50	Subcutaneous suture (Ch)	+	Chromic	Normal
550	Subcutaneous suture (Ch)	+	Chromic	Normal
562	Intraperitoneal injection (Ch)	—	Chromic	Normal
563	Intraperitoneal injection (Ch)	+	Chromic	Normal
555	Subcutaneous suture (Pl)	+	Plain	Abnormal
551	Intraperitoneal injection (Pl)	—	Plain	Abnormal
554	Subcutaneous suture (Ch)	+	Chromic	Abnormal
564	Intraperitoneal injection (Ch)	+	Chromic	Abnormal
550	Subcutaneous suture (Ch)	+	Chromic	2nd day disrupted
553*	Laparotomy (Ch)	—	Chromic	4th day disrupted
55	Subcutaneous suture (Pl)	+	Chromic	3rd day disrupted
583*	Subcutaneous suture (Pl)	Not tested	Plain	5th day disrupted
552	Laparotomy (Pl)	+	Plain	4th day disrupted
560	Intraperitoneal injection (Pl)	+	Plain	3rd day disrupted
585	Control	—	Chromic	Normal
559	Control	—	Chromic	Normal
584*	Control	—	Plain	Normal
586	Control	—	Plain	Normal
557	Control	—	Plain	Normal
553	Control	+	Chromic	Abnormal

#### SUMMARY

Sensitized with	Wound healing after laparotomy		
	Normal	Abnormal	Disrupted
Plain	3	2	3
Chromic	3	2	3
Control plain laparotomy	3	0	0
Control-chromic laparotomy	2	1	0

\*Photographs

patients had histories of allergy and 32 had histories of previous operations. Twenty-six of these patients survived, and we were able

TABLE III—INTRADERMAL TESTS TO SUTURE MATERIAL

Procedure	Non allergic	Allergic	Material tested					
			Catgut			Chromic		
			+	±	-	+	±	-
Non allergic	66	8			5			5
Allergic	7		9		6			60
Disrupted suture		5						
Non allergic	3							3
Allergic								
Disrupted suture								
Non allergic	5	4			3			3
Allergic								

Continued (see—non allergic)

to determine the sensitivity of 19 of these Intradermal skin tests were made the same type of extracts of plain and chromic catgut being used as in the animal experiments and in addition their sensitivity to chromic acid was determined. Of the 19 patients tested 4 reactions were observed 1 to plain 10 to chromic catgut and 10 reacted to chromic acid as is shown in Table III. It is particularly interesting to note that all 4 of the allergic patients of this group showed sensitivity to one or more antigens. It was also thought that other allergic patients in the clinic might show a sensitivity to catgut or chromic acid. Of a total of 101 patients 37 gave a response to one or the other as is shown in Table III. Finally the incidence of sensitivity in a relatively normal group of patients taken in the hospital wards and in the clinic would be most instructive. Of this group of 103 only 22 were sensitive to one of the three antigens.

It is evident therefore that relatively normal patients are only occasionally sensitive to catgut or the chromic acid in it. The next highest proportion exists in the allergic group and the highest in the case which is disrupted while all of the allergic patients who disrupted were sensitive. The impression must not be left however that all cases of disruption may be explained with lack of sensitivity to catgut but this certainly appears to be a factor particularly in patients who have had a history of allergy.

## CONCLUSION

1 The presence of flaws and foreign bodies in catgut emphasizes the necessity for careful examination of the product before it is used. Some method of supply other than in narrow glass tubes which kinks the gut at each bend should be devised.

2 By making catgut anhydrous so that it may be boiled its properties of flexibility are lost and in most cases its absorption time is shortened.

3 During absorption of the protein in catgut the metal and halogens it contains are liberated and may set up a local irritation in the tissue thus interfering with wound healing. This is particularly true of chromium to which individuals may also be sensitive.

4 It is possible to sensitize guinea pigs to catgut and to produce disruptions of laparotomic sutured with this material. Non allergic patients may be occasionally sensitive to it while allergic patients are quite often sensitive. The highest incidence of sensitivity was a group in which wound disruption had occurred and all allergic patients who had disrupted exhibited a sensitivity to one or more antigens. There may be a relationship between wound disruption and sensitivity to catgut or chromic acid in certain individual patients particularly if they have a history of allergic preparations or exposure to chromic acid. It is recommended that if catgut is to be used particularly in these instances the

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sensitivity of the individual should be determined by appropriate skin tests

The author wishes to express his great appreciation to Mrs Janet Cimatti for her efficient voluntary technical assistance and to Miss Margaret Himhn for assisting with the chemical analyses

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Fig 3. The right and left sides of the abdomen are shown. The right side is the side of the patient. The left side is the side of the operator. The right side is the side of the patient. The left side is the side of the operator. The right side is the side of the patient. The left side is the side of the operator.

excreted in a large proportion of cases of intrahepatic block is generally known. However in such cases whatever dye is visible 20 hours will have passed from the biliary tract to the intestine before 48 hours has elapsed while in the presence of a non functioning gall bladder the dilated bile ducts should become visible.

#### CLINICAL APPLICATION

Accordingly dye was given to 17 patients suffering from well developed jaundice 12 of whom were completely blocked. The first 3 patients were given 250 milligrams of iodikon in 1000 cubic centimeters of a 10 per cent glucose solution. This procedure was repeated three times at 48 hour intervals according to the schedule here outlined. The next 3 patients were given 500 milligrams at a dose and the rest 750 milligram each dose. For the first 3 patients the dye was mixed with 20 cubic centimeter of distilled water filtered and emptied directly into the flask of glucose solution. No reactions were noticed other than the occasional chills which may



Fig 4. The right and left sides of the abdomen are shown. The right side is the side of the patient. The left side is the side of the operator. The right side is the side of the patient. The left side is the side of the operator. The right side is the side of the patient. The left side is the side of the operator.

follow administration of glucose alone. At the bottom of the emptied flasks which had been standing over night there was sometimes a small amount of precipitate but the precipitate from the mixture of glucose and dye forms very slowly and if the solution is administered immediately after mixing no concern need be felt over reactions from the residue. The last 11 patients were given three 750 milligram doses of dye at 24 hour intervals instead of 48. Pictures in every case were taken 20 hours and again 48 hours after administration of the last dose of dye. A fat meal was given after the 24 pictures were taken. In those cases in which the gall bladder or bile ducts were unable to empty because of block at the ampulla pictures were taken at interval up to a week after the last dose of dye had been given.

By operation autopsy or cholecystography after the jaundice had cleared 12 of the 17 patients were shown to have intrahepatic block. Of these 12 3 showed clear cut gall



FIG. 5. This shadow of a smooth flaccid gall bladder was seen 20 hours after administration of dye. The gall bladder emptied and there was no shadow at 48 hours. Although the history and pain were typical of stone catarrhal jaundice was found upon operation.

bladder shadows at 20 hours, which in every respect corresponded to that of a normal gall bladder. None showed a shadow after 48 hours (Fig. 5).

Two of these patients were operated upon in spite of normal cholecystography because of the typical history and physical findings of common duct stone and because they were observed in the hospital during attacks of colic which were identical with that produced by a stone. At operation the gall bladder and bile ducts in each case were normal. The patients subsequently recovered and were discharged with a diagnosis of catarrhal jaundice. Four of the 12 proved to have carcinoma of the liver, 2 at operation and 2 at autopsy. The primary site of the tumor was in the gall bladder in 2 cases, and in the hepatic ducts and ovaries in 1 each. In all 4, the block was above the junction of the cystic and common ducts and no dye could

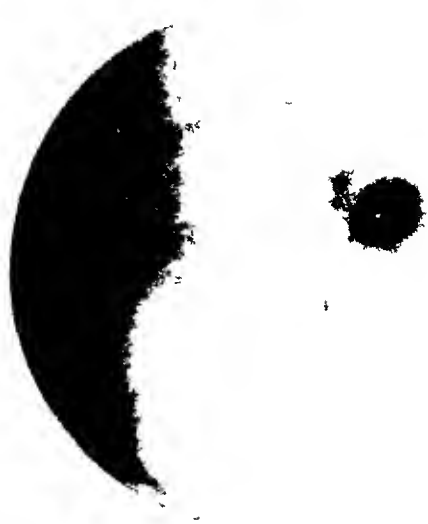


FIG. 6 (RC). A clear gall bladder outline is shown 48 hours after dye administration. Shadows simulating stones are seen due to pooling of the dye on standing. Jaundice of 3 months' duration was due to carcinoma of the head of the pancreas.

be concentrated in these gall bladders. Roentgenograms consistently showed no gall-bladder or duct shadows and in the two operative cases surgical relief was impossible. This, we felt, had already been indicated by negative cholecystography. Two patients revealing no shadow recovered under medical care. The clinical diagnosis in each case was catarrhal jaundice, but no subsequent cholecystograms could be obtained to corroborate this diagnosis. We have found, however, that at certain stages in acute catarrhal jaundice, no dye is excreted by the liver, and we place these two cases in that class.

One patient (RC) had been jaundiced 3 months. During the last month she was confined to the hospital with a complete obstruction of the common duct. The diagnosis was uncertain, the opinions of the attending staff being about evenly divided between intrahepatic and extrahepatic block as the cause of jaundice. The gall bladder could not be felt because, as was later found, it pointed posteriorly and downward. Plain plates, negative. Those taken 48 hours after a course of 750 milligram doses of dye revealed a dilated gall bladder apparently filled with small stones.



Fig 7 The same patient (RC) 5 days after the last dose of dye. The gall bladder is emptied with the dye settled to the top of the fundus.



Fig 8 (JL) First shadow of the gall bladder after dye administration. The dye is settled in the fundus.

The gall bladder still visualized well at the end of 3 days and after 5 days the dye was shown settled to the bottom of the gall bladder cavity.

This patient refused an operation and remained completely blocked until her death 6 months later. A small carcinoma of the head of the pancreas completely blocking the duct was found at autopsy. The ducts and gall bladder were greatly distended but contained no stones. The appearance of stones in Figure 6 was caused by the uneven distribution of the dye on remaining in the gall bladder over a long period of time.

The sixteenth case was a 77 year old man (JL) who had been completely blocked for 9 months. Dye was administered by the method described without reaction and pictures showed faint shadows of stones outlined by dye (Fig 8).

These stones did not show on a plain plate. Because of the roentgen ray studies and his good physical condition a laparotomy was

done and the common duct was found to be tremendously dilated and filled with stones. The gall bladder was a mass of fibrous tissue.

The last patient had a painless jaundice of 6 weeks duration. A large smooth mass could be felt at the liver edge which was evidently a distended gall bladder. Roentgen ray plates after dye injection showed a large smooth edged pale shadow corresponding to the location of the mass. The identity of the shadow with the gall bladder could not be confirmed as the patient refused operation and autopsy could not be obtained after death some time later. We were certain however that the shadow revealed was that of the distended gall bladder.

#### SUMMARY

Iodikon given according to the method described to a group of 17 jaundiced patients after preliminary administration to 10 jaundiced dogs is not followed by bad reaction either immediate or delayed. The extra hepatic biliary system can be visualized in every dog even though as long a time as 3



months may have elapsed after production of jaundice by ligation and division of the common bile ducts. In the absence of the gall bladder in one dog the bile ducts were well visualized. Likewise the biliary system can be demonstrated in patients suffering from common duct obstruction. The shadows obtained remained visible in both animals and patients for a period of 48 hours or longer. This is greatly in excess of the normal emptying time of the unobstructed extrahepatic biliary system, the extreme limit of which is 36 hours (2).

The observations here reported show that the liver will excrete the dye in the presence of complete common duct obstruction of long duration and that this dye which has reached the extrahepatic biliary system is held there by the duct obstruction. Furthermore, the dye is not resorbed from the gall bladder but remains visible by roentgen-ray for 48 hours or longer and clearly demonstrates common duct obstruction.

The dye held in the gall bladder over a long period is often unevenly distributed or gathered in pools, giving a false appearance of stones. It also may settle to the tip of the fundus, giving a dense, semilunar shadow if the patient has remained quietly in bed.

On the other hand, the dye given to patients with jaundice due to intrahepatic obstruction fails to visualize the biliary system in a single case after 48 hours. Although normal gall bladder shadows may be seen at 20 hours, the gall bladder empties at 48 hours and no shadow is cast. Two of 3 such patients with clinical pictures of common duct stone proved at operation to have catarrhal jaundice. The gall bladder and bile ducts were normal.

The diagnosis without the roentgen-ray is uncertain in many cases of jaundice in spite of the fact that full hospital and laboratory facilities are at hand, but may be made by the method described in some instances. With our present meager experience with this method, we feel that it offers an effective means of differentiating intrahepatic from

extrahepatic biliary obstruction in most cases, and would confidently withhold operation where such tests give positive evidence. The routine administration of the dye by this method takes several days but does not delay treatment inasmuch as several days' hospitalization and pre-operative glucose administration is required.

### CONCLUSIONS

- 1 Dye given intravenously in divided doses with glucose is excreted by the liver in the presence of complete block of the common bile duct, of either short or long duration.
- 2 Dye so excreted is not resorbed from the gall bladder but remains and is radio-opaque at least several days to a week.
- 3 If the extrahepatic biliary system is visible by roentgen-ray more than 48 hours, the obstruction is in the common duct.
- 4 The presence of a functioning gall bladder is not necessary for the roentgen-ray demonstration of common duct block by this method, since the bile ducts outside the liver will visualize even if the gall bladder is absent.
- 5 The method offers a reliable scheme of differentiating extrahepatic from intrahepatic biliary block in jaundice.

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SURGERY GYNECOLOGY AND OBSTETRICS

DURATION OF VOLUNTARY ABSTINENCE IN HYKOTOXICOSIS

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WILLARD BARTLETT JR MD FACS Sr Lect Missouri  
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A NOTE as to our interest in the development of the breathholding test in thyrotoxicosis may not be amiss since there have been no contributions by other authors to the subject to the best of my knowledge. Some 10 years ago my father observed that intensely hyperthyroid patients not yet properly stabilized for operation could not be anesthetized fully with nitrous oxide oxygen without accompanying cyanosis and that postoperative deaths in this group crisis occurred almost entirely in this group. These patients were thereafter recognized following induction of anesthesia but before operation was started and were returned to their beds without operation. Their obvious intolerance of the slightest withdrawal of oxygen led him next to the observation that they could not hold their breath to anything like the normal duration. In postponement of operation in such a patient until a radical improvement in the ability to hold the breath occurred was followed by induction of anesthesia without clinical cyanosis diminishing of the incidence of alarming increase of pulse rate and blood pressure during operation and a smooth postoperative course. I first became familiar with these facts in 1928 and have attempted to systematize an investigation into the ability of the thyrotoxic patient to hold his breath during the course of the disease to correlate change in this ability with the other tests by which we estimate improvement in his condition and to determine the value of this physical sign as a criterion of operability.

It seemed desirable at an early date to test the ability to hold the breath in two phases after a maximal inspiration and after a maximal expiration and the technique of the test to which we have adhered was published in 1930 (1) and has been referred to since (2-5). The preliminary report embracing a review of the literature on breathholding to test in health and disease, their correlation

with vital capacity an outline of the mechanism of the regulation of respiration so far as the experimental literature takes us and a detailed study of observations at interval on 35 patients this established certain facts which have been largely confirmed by our experiences in the 4 years subsequent to that publication. The physiology of respiration is still obscure enough that we can go no further in explaining the reaching of a breaking point during voluntary apnea than Gesell's conclusion that it is determined by the acidity of the respiratory center itself and that this coincides with the hydrogen ion concentration of the blood only under special conditions. There has not yet been published well substantiated evidence of changes in any of the factors influencing the efficiency of the arterial blood as a carrier of hydrogen ions in thyrotoxicosis to account for variation in the acidity of the respiratory center from this source nor are there clearly established changes in tissue metabolism to which the complex buffer system of the center itself can be shown to be inadequate in maintaining normal hydrogen ion concentration. Consequently we are unable to throw any further light on the physiological basis for the breathing test at this time than we could in our preliminary report. (That there is no constant relationship between duration of voluntary apnea and vital capacity has been amply shown.)

The present paper will confirm the previous finding, that in thyrotoxicosis there occur (1) a decrease in the duration of the apneic interval in both phases and (2) a characteristic alteration of the *relationship* between their numerical values and that a return toward normal value occurs as the patient improves and achieves sufficient stability to with stand operation. Further evidence of the correlation of the test with other clinical and laboratory data such as pulse rate, blood pressure and basal metabolism will be presented in

subsequent papers. Determinations on patients with congestive heart failure (decompensation), anemia, nephritis or ketosis associated with diabetes mellitus are not included in the figures to be given.

#### TECHNIQUE OF TEST AND NORMAL VALUES

The test is performed under basal conditions (for purposes of investigation). A simple explanation of the plan of testing, of its safety, and of its value to the patient is always made and is necessary to insure against false starts or failure to reach a true breaking point with consequent frequent repetition of the test. It is not true that the patient improves with practice but it is importantly true that the examiner does, familiarity with the procedure enables one to recognize less than maximal effort, patience in securing the attention and co-operation of the patient before the test is started and intelligent coaxing or urging during the test minimize the occurrence of false values. The duration of the apneic interval after expiration is usually made first. A maximal inspiration is taken, followed immediately by a maximal expiration and the nares are lightly compressed by the examiner's fingers, the duration is counted with the watch from the *start* of the expiration until the breaking point is reached, since some persons will exhale in 2 seconds whereas others, in spite of example and instruction, will exhale over a period of 5 or even 10 seconds. After a rest period of at least 5 minutes the inspiratory phase is determined, a maximal inspiration is taken, followed at once by a maximal expiration and the ensuing maximal inspiration is held, with compression of the nares as before. The duration is measured from the start of the final inspiration since some persons fill their lungs more rapidly than others.

The duration of the inspiratory phase is then placed over the duration of the expiratory phase and the fraction thus obtained expresses the duration of voluntary apnea which we abbreviate for convenience to "D V A." The *arithmetical value* of the fraction (numerator divided by denominator) we call the index of stability. For example, an inspiratory phase of 40 seconds and an ex-

piratory phase of 20 seconds is recorded as D V A 40/20, index 2.

Since preliminary inspirations increase the apneic interval, our figures on non-thyrototoxic patients are not exactly comparable with determinations made by other techniques. Such preliminary inspirations, however, have seemed essential to insure complete emptying or filling of the chest, as the case may be, in the phase to be measured, this simply takes into account the inability of the average thyrototoxic patient to concentrate his attention readily on any task. Since the ability of healthy persons to hold the breath under basal conditions varies so widely with physical training (vocational or avocational), it is impossible to set definite limits of normal. Averages, however, of large series of normal individuals, are reported by various authors. Wittich and Polczak give an average of 56 seconds and 36 seconds for inspiratory and expiratory phases, respectively, in a group of 275 men in a gymnasium class and 47 seconds and 31 seconds for a group of 63 university women (the expiratory phases are determined here after normal, not forced, expiration), Jackson and Lees, using the same technique in 100 university students, report averages of 72 and 33 seconds with ranges of 34 to 176 and 14 to 96 seconds for inspiration and expiration, respectively, after maximum expiration the average was 24 seconds with a range of 11 to 75. It is obvious, therefore, that with such a wide range of results on persons in health, one can only estimate as best he can the *expected* normal of any person suffering from a disease which decreases his ability to hold his breath. It is my own impression, as a result of making perhaps a thousand tests on patients with toxic and non-toxic goiters, that men in general and young women who have had regular exercise, particularly in organized athletics, will reach and exceed 45 seconds after expiration (under basal conditions in health) and that the duration of apnea after inspiration will be about twice as great. On the other hand, persons, particularly women, who have led sedentary lives and have accumulated the usual amount of fat in early middle life will not often exceed 30 seconds in the expiratory phase, the in-

spiratory phase: again about twice as long with the technique described. From these two main groups come the thyrotoxic patients as we see them. As they return to health the breathholding ability returns to the expected duration which can be predicted with fair accuracy. Nevertheless the wide range of normal values and the impossibility of prediction with absolute accuracy of the duration of voluntary apnea in health make a series of observations on any patient of considerably more importance as an indication of improvement than does a single estimation considered as an absolute expression of his clinical condition at that time. Knowledge of previous estimation whether the patient was worse or better in general distinctly adds to the certainty with which the test can be applied when action is contemplated.

The index of lability is of equal importance perhaps. As has been said, determinations on normal individuals with the technique described show the inspiratory phase to be about twice as long as the expiratory phase. Actually the index varies within very narrow limits in health from person to person and the variation in the findings between 1.8 and 2.0 is probably an expression of the limits of error inherent in the method of starting and finishing the timing. It is characteristic of acute untreated thyrotoxicosis that a deviation away from the normal index is always found. The index approaches a value of 1.0 in the majority of the patients we see; they come from the group of individuals who are best characterized as being housewives of sedentary habits and though both phase of voluntary apnea decrease as the patients become thyrotoxic the actual duration in both phases may become practically the same. A minority of patients present themselves with values above 2 for their indices; these persons in health belong to the group who are physically active and run quite true to form in having had special training of one sort or another. In them the reduction of the duration in both phases during thyrotoxicosis is proportionally greater in the expiratory phase than in the inspiratory and the index on first examination may be 3.0 or even 3.5. But in both groups

improvement in clinical appearance is accompanied by increase in both phases of breath holding ability and by an improvement in ratio toward the normal.

#### PRESENT MATERIAL

In the material presented herewith only the findings in those patients who belong to the majority group are included in order to show the typical changes in duration of voluntary apnea and index at varying levels of thyrotoxicosis. The inclusion of figures for the minority group and the averaging of both together only obscure the characteristic behavior of each. The data on the minority group will be presented in a separate paper.

The 178 observations on 111 patients have been recorded in respect to pulse, blood pressure, basal metabolism, duration of voluntary apnea, circulatory compensation, and weight as well as other clinical characteristics with sufficient completeness that they are useful in critical analysis. These observations (except determinations of basal metabolism) have been made personally by the author and were made on patients in only one hospital. The patients fall naturally into four groups. Group 1 (12 cases) consists of non-thyrotoxic patients. Group 2 (59 cases) consists of those hospitalized only once and having subtotal thyroidectomy (or single lobectomy occasionally in the case of unilateral growth). Group 3 (11 cases) consists of patients who were hospitalized only once but who had separate lobectomies (2 stage operation) performed at that hospitalization. Group 4 (49 cases) includes all patients hospitalized more than once. It consists of (a) patients who (in 1930 and 1931) had upper pole ligations and returned for thyroidectomy in 1 or 2 stages; (b) the patients who had separate lobectomies at different hospital stays; and (c) a few patients who were hospitalized when on the verge of crisis, discharged for home treatment for periods varying from 1 month to 4 months and brought back for operation in 1 or 2 stages (these individuals would have had pole ligations performed at first hospitalization prior to 1932; we no longer regard pole ligation as being of therapeutic benefit—3). In passing, it may be said that the minority

group excluded from this presentation consisted of 22 thyrotoxic patients, 12 in Group 2 and 10 in Group 4. These figures must not be taken as indicative of the percentage of cases in our practice in which more than one hospitalization is required, or in which 2 stage operations are performed, it is natural that records kept with detailed completeness sufficient for investigative purposes are most apt to be those in which the patient is so sick that exact thinking is required. Only a minority of our mildly thyrotoxic and non-toxic goiter patients during the period of this study (June, 1930, to June, 1933) are included.

The following illustrations record the progress of individuals in the 3 groups of thyrotoxic patients

Group 2, Case 53, Miss P. N., aged 51 years, admitted March 5, 1931, diffuse hyperplastic goiter  
March 5 Pulse, 105, blood pressure, 128/55-40, D V A, 33/21, index, 1.6, basal metabolic rate, +34 on March 6

March 8 Pulse 100, blood pressure, 110/70, D V A, 40/25, index, 1.6

March 16 Pulse, 84, blood pressure, 120/80, D V A, 70/40, index, 1.8, basal metabolic rate, +14

March 17 Subtotal thyroidectomy, slight reaction

March 26 Pulse, 90, blood pressure, 110/80, D V A, 116/62, index, 1.9, basal metabolic rate, -3, discharged

Group 3, Case 11 Mr R. H., aged 30 years, admitted June 26, 1933, with diffuse hyperplastic goiter

June 27 Apex, 120 (fibrillating), D V A 45/28, index, 1.6, basal metabolic rate, +91

July 5 Apex, 98 (fibrillating), D V A, 45/38, index, 1.2, basal metabolic rate, +50

July 10 Apex, 86 (fibrillating), D V A, 63/35, index, 1.8, basal metabolic rate, +57

July 12 Right lobectomy, moderate reaction

July 19 Apex, 84 (fibrillating), D V A, 72/43, index, 1.7, basal metabolic rate, +32, left lobectomy

July 27 Pulse 84 (regular), blood pressure, 125/75, D V A, 95/48, index, 2.0, basal metabolic rate, +4, discharged

Group 4, Case 28 Mrs H. L., aged 52 years, admitted June 2, 1931, diffuse hyperplastic goiter

June 5 Pulse, 120, blood pressure, 210/80-50, D V A, 15/12, index, 1.3, basal metabolic rate, +91, weight 145

June 9 Pulse, 96, blood pressure, 170/65-30, D V A, 30/20, index 1.5

June 11 and June 17 Ligations

June 27 Pulse, 90, blood pressure, 174/70-0, D V A, 23/20, index, 1.1, basal metabolic rate, +77, weight, 131

June 29 Discharged

October 13 Readmitted

October 15 Pulse, 108, blood pressure, 185/80, D V A, 25/17, index, 1.5, basal metabolic rate, +74, weight, 158

October 27 Pulse, 96, blood pressure 190/90, D V A, 40/28, index, 1.4, basal metabolic rate, +26

October 29 Right lobectomy, moderate reaction

November 9 Pulse, 98, blood pressure, 198/78-0, D V A, 36/22, index, 1.6, basal metabolic rate, +20

November 12 Pulse, 90, blood pressure, 150/65, D V A, 40/27, index, 1.4

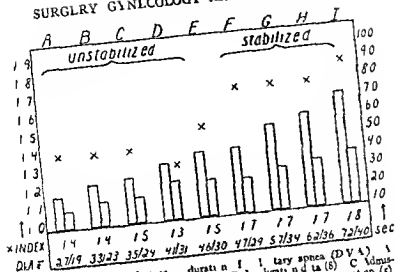
November 14 Left lobectomy, moderate reaction

November 26 Discharged

The graphic recording of a group of such records presents something of a problem in itself and I wish herewith to express my gratitude to Evarts Graham for his suggestions in the preparation of this material for publication. The accompanying chart shows graphically the changes in the duration of voluntary apnea and indices throughout the range of thyrotoxicosis in these patients

#### DISCUSSION OF CHART

As indicated, the data in columns A to E, inclusive, are those of patients who can be said to be as yet unstabilized whereas those in columns F to I are stabilized, the last, of course, being non-thyrotoxic. In reviewing individual cases it is seen that the dividing line is not sharp, but the average index of non-stabilized patients is 1.5 or less and the index of the stabilized patient ranges between 1.7 and 2.0. Moreover, the margin between columns E and F is negligible so far as duration in either phase is concerned. It is here that series observations are of most value, and it is partly on the basis of improvement over previous tests and partly on other clinical criteria that the patients in column F were considered to be stabilized and those in column E were thought not to be. Column F is a composite group made up of immediately pre-operative data on all patients having first lobectomy in a planned 2 stage operation. This includes three subgroups: (1) 12 patients discharged from the hospital after the first stage for an average interval of 95 days between stages. The average duration of their ability to hold their breath is

[illegible]

45/27 index 16 they are characterized by being over 50 years of age and having thyrotoxicosis of long duration with extreme loss of weight. Such individuals do not often become reasonable risks for 1 stage operation in our experience. They show moderate early improvement on first hospitalization (see admission data in column C) but do not spontaneously improve further. (2) Six patients who had previously been hospitalized (4 ligated) returned for 2 stage operation at the second hospitalization they had been extremely thyrotoxic on first admission 2 having been delirious and 2 others having been decompensated. (Most of them appear in column A.) In the immediately prelobectomy phase there was still so marked a tachycardia in these patients that we were unwilling to risk subtotal operation and the fact that the postoperative reaction was more than mild in 4 cases convinces us that we were not overcautious. Their average duration of voluntary apnea was 49/34 index 14 immediately before first lobectomy. (3) Observations were recorded before first lobectomy on 9 patients who were hospitalized only once and had 2 stage operation performed. They

were marked clinically by being under 30 with one exception but with considerable weight loss and an average basal metabolic rate of +60 on admission. Of these patients 5 were men which raises the average duration of voluntary apnea on admission somewhat and 3 showed little or no improvement in duration of voluntary apnea over admission figures (see column E). Postoperative reaction following the first lobectomy was characterized as moderate in 5 and 2 other patients had very severe reaction. The average duration of voluntary apnea was 49/27 index 18 before first lobectomy.

The same groups of patients appear in column G and it is worth emphasizing that a patient sick enough to require 2 stage operation should be measurably in as good condition for the second lobectomy as for the first. If division of the operation into stages is truly warranted the first stage will use up all the energy the patient can spare and he will not regain his pre operative status in a few days. The average interval between stages was 11 days in those cases here mentioned who were hospitalized more than once and in whom no direct attack on the gland

was made at first hospitalization. In the patients hospitalized only once, the average interval between stages was 12 days. We have thus avoided in recent years the deaths after second stage operation that formerly occurred from the assumption that because first lobectomy had been well tolerated, second lobectomy could always be done within a week or so. The re-estimation of the duration of voluntary apnea shows us that stability is not often regained so soon.

Column H requires little elucidation. There is little difference in the averages of the 3 subgroups which compose it. (1) Single observations immediately before subtotal thyroidectomy were made on 34 patients hospitalized only once, the duration of voluntary apnea 65/36, index 1.8. (2) Observations immediately before operation were also made on 20 patients on whom observations on admission had been made (see column D), pre-operative duration of voluntary apnea 56/35, index 1.6, average interval 8 days. (3) On 9 patients returning to the hospital for subtotal thyroidectomy at an average interval of 147 days following ligation of upper poles, average duration of voluntary apnea 61/37, index 1.7. There was little difference, therefore, between the patients judged to be suitable for subtotal thyroidectomy whether the length of time necessary to achieve stability was 10 days or several months. But, as has been mentioned in the discussion of column F, a group of 6 patients previously ligated and judged to be suitable only for 2 stage operation on return showed a duration of voluntary apnea of 49/34, index 1.4, before the first lobectomy. Between these two groups the difference in duration of voluntary apnea is therefore readily measurable.

Column I requires no discussion beyond the pointing out that here the largest average values for duration of voluntary apnea are found with, of course, a characteristic index of stability. It is the one extreme of the picture of which the other is column A which presents admission observations on patients too sick to permit of any direct attack on the gland (if one excepts ligation) within a period of 2 to 3 months from the time they first present themselves for treatment.

#### CLINICAL APPLICATIONS

Like many other methods of investigation of the deranged physiology of thyrotoxicosis the estimation of duration of voluntary apnea is not necessary to the safe handling of only mildly hyperthyroid patients. But we find it invaluable in making the decision between subtotal thyroidectomy and 2 stage operation (separate lobectomies with an interval of weeks or months between them) for the severely thyrotoxic individual. One faces this choice in two situations. (1) with the patient who is making a slow but steady recovery after having recently been in desperate straits due to cardiac decompensation, diarrhea, loss of over one-third of average weight, etc., (2) with the patient who remains quite refractory to treatment and is moderately thyrotoxic over a prolonged period. In such cases, all other criteria (3) being satisfactory, the findings of voluntary apnea of the stabilized type, however (ample duration with index of 1.7 to 2.0) encourages us to risk 1 stage operation, in the presence of a voluntary apnea of the unstabilized type, however (index lower than 1.5, regardless of duration) we will do only a 2 stage operation and the postoperative reaction of these patients rarely leads us to think that we have been too prudent. Finally, the objective value of voluntary apnea duration in re-establishing operability of the patient between first and second stages has previously been mentioned.

Even after becoming thoroughly familiar with the use of the test, one need not expect to find a close, constant parallel between changes in the duration of voluntary apnea, pulse rate, basal metabolism, etc., in the progress of a case. There is a general correlation in these and other criteria as the patient grows better or worse, but there is so obviously a selective mechanism at work in thyrotoxicosis, in that the chief expression of the disease varies among different organ systems from case to case, that the patient is rare who improves in all respects at the same rate. Our various clinical criteria in thyrotoxicosis to which the breathholding ability test is an addition, probably measure quite dissimilar facets of this many sided disease.

## CONCLUSIONS

1 Inability to hold the breath to normal duration is described as a physical sign in thyrotoxicosis

2 In both inspiratory and expiratory phases the duration of voluntary apnea (D V A) is diminished and there is a characteristic alteration of the relationship between them (index of stability)

3 In typical untreated thyrotoxicosis the index of stability tends to approach a value of 1.0. Clinical improvement is accompanied by a reversion toward normal range 1.8 to 2.0

4 The ultimate physiological basis for the test is uncertain

5 Typical changes in regard to duration of voluntary apnea (D V A) and index of stability in 111 patients with varying grades of thyrotoxicosis are shown graphically in a chart

6 The clinical application of the breath holding test is discussed

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ACUTE PELVIC APPENDICITIS<sup>1</sup>

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**T**HE purpose of this paper is to bring forcibly to your minds a certain form of appendicitis with atypical symptoms, a form of appendicitis which is often overlooked, at least in its early stages.

We have found that when the appendix is pelvicly placed, either over the brim or deep within the pelvis, the symptoms arising when it becomes inflamed are most unusual. On the other hand, it is our belief that as a rule an early diagnosis can be made if we consider this type of appendicitis an entity and recognize the peculiar symptoms which it produces.

In looking over the literature, every once in a while one comes across the term "pelvic appendicitis", but, so far as I know, no one has mobilized all the symptoms, and I might also say the lack of symptoms, which cause the surgeon to suspect the diagnosis. In an article by A. R. Short<sup>2</sup> on "Abdominal Pain in Children," he says, in speaking of appendicitis, "Difficulty in the diagnosis is caused by the pelvic appendix both in children and adults. In the great majority of unrecognized and fatal cases of appendicitis, the appendix is of this type."

Such observations as these have been made many times, but no one has brought together in a concrete way the various symptoms which may make it possible to reach an early diagnosis with a certain amount of assurance. On our surgical services we have for many years used this term, and have had definite criteria on which to base a diagnosis. During the past few years 90 per cent of the cases of ruptured appendix referred to me, either for operation or for consultation, have been of this group.

The constant symptom is pain, usually very severe, which at the onset does not differ particularly from that of any appendiceal attack. In referring back to the histories of these cases, I find that the pain may start in the epigastrium or around the umbilicus, but soon settles in the lower abdomen. In the great majority of cases, the history is that of a

well individual waking up suddenly at night with a severe abdominal pain that prevents sleep. When localization of the pain takes place it is more frequently on the left than on the right side. In older individuals, diverticulitis must therefore be thought of, but in young people this seldom enters into the diagnosis. While at times the pain may be on both the left and the right sides, or on the right side alone, in our series of cases it is more commonly complained of on the left, and this to us is the first indication of a possible pelvic appendicitis.

Vomiting may or may not ensue. Many times it is brought about by an attempt to take some cathartic such as salts, but it is not persistent.

Diarrhea should be mentioned also, not as a special symptom of pelvic appendicitis but rather to draw attention to the fact that diarrhea is not uncommon in appendicitis.

The onset, therefore, is not different from that of any attack of appendicitis, and appendicitis is usually considered among the diagnostic possibilities. On examination, however, the findings are so atypical that reasonable doubt is thrown on this diagnosis. We find practically always a normal temperature, an abdomen that is flat and soft, and a total absence of rigidity. In these cases we may go over the abdomen again and again, with deep palpation, without an expression of pain or tenderness on the part of the patient. On consultation, these facts are always brought out by the physician in charge, in justification of his delay. It does not seem to be general knowledge that there is such a group of cases with these negative findings.

The fourth symptom which is often present in these cases, and usually overlooked, is irritation on urination. In most cases this point must be brought out by direct questioning, and when so done the patient will recall that he did have irritation on urination for a few hours, and perhaps frequently. In some cases the symptoms of irritation are dominant, and

<sup>2</sup>Short A. R. Abdominal pain in children. *Brit. M. J.* 1935, 1: 1157.

<sup>1</sup>Read at the meeting of the Western Surgical Association at Rochester, Minnesota, December 6-7, 1935.

# SURGERY GYNICOLOGY AND OBSTETRICS

we have several on our list where cystoscopic and ureteral examinations were made in search of a diagnosis although in each case appendicitis was considered possible in the early stages

If the appendix is very low in the pelvis and underneath the bladder there may be a rather constant desire to move the bowels—so that we consider these two symptoms of importance—desire for urination and desire to defecate

On urine examination red blood cells are frequently found in the urine. Ten to 20 cells are common. We believe that the appendix in such cases is often placed near the ureter causing irritation and that this finding should not be used to stop a diagnosis of appendicitis as has frequently been done.

The blood count is one of the most important single factors in diagnosis. The white count is usually high, 15,000 to 20,000 with a high polymorphonuclear count. In only a few of our cases has there been a low count, 8,000 to 10,000, but in such cases the polymorphonuclear count has usually been high.

We have then a patient who looks well who gives a history of severe abdominal pain which after 12 hours has probably eased off who has a normal temperature, a soft belly and absence of rigidity and tenderness, whose pain when complained of has localized itself usually in the left lower quadrant rather than on the right, who has had some symptoms either of urinary or rectal irritation and who has a moderately high white cell count with an increased polymorphonuclear count.

Rectal examination is now of first importance to verify the diagnosis of pelvic appendicitis. While at the present time such examinations are more frequently made than in the past, I believe that many of them are really perfunctory. With the possibility of a pelvic appendicitis well in mind, this examination should be done thoroughly, preferably on a hard table. In a fat individual it is difficult enough ordinarily, and with the patient in a soft bed becomes practically impossible. I would further urge that one examination is not sufficient. When seen early the tenderness may not be made out with definiteness and rectal examination should be repeated at

least once or twice a day until a definite finding is made. In this way only can an early diagnosis be approached and rupture of the appendix avoided.

Attention should be drawn to the fact that tenderness on rectal examination is noted early in those cases in which the appendix is low down in the pelvis and is difficult to elicit where the appendix is just over the brim of the pelvis. In these latter cases symptoms of rigidity and tenderness near Poupart's ligament come on fairly early which helps in making a diagnosis.

The second 24 hours usually show a gradual and very moderate rise of temperature. If there has been no rise in the leucocyte count there will be a definite rise in the polymorphonuclear count by this time, and if a Schilling count is made there will be found a distinct shift to the left. The left-sided pain may persist but rigidity may still be absent. The severe pain usually diminishes and the patient feels as if he should go to work and efforts being kept in bed. Finally when rupture occurs—and this often is very sudden and unexpected—the picture changes instantly. There is sudden severe pain marked rigidity and dullness over the right or left side or both and over the pubis—all the signs of an intra-abdominal calamity.

In some cases the rupture is so sudden and the shock so great that epigastric pain makes the diagnosis of ruptured ulcer possible but usually the symptoms are below the umbilicus. The bladder symptoms may increase. The rupture may be localized or it may be general.

In girls and young women certain variants must be taken into consideration. In the first place the appendix is frequently separated from the bladder by the broad ligaments and the uterus and bladder symptoms and blood in the urine are found less frequently.

I should like to emphasize again the importance of the negative symptoms in the making of the diagnosis. It is customary on our surgical services to put as much stress on the negative findings of absent fever and absence of pain and rigidity in a case that begins like appendicitis as on the positive signs. Unless we make this type of appendicitis a distinct entity these negative findings are misleading.

A discussion of acute pelvic appendicitis would not be complete without a careful consideration of the diseases which it is most likely to be mistaken for, or that may be mistaken for it. Three conditions have especially presented themselves to us: first, salpingitis, second, hemorrhage from an ovarian follicle into the abdominal cavity, and third, stone or gravel in the right ureter.

Probably more mistakes are made in the differential diagnosis of salpingitis than of any other one condition, and below I relate two interesting cases of this group. The early signs and symptoms of these two conditions can be very similar. In salpingitis the blood count may be higher, but it is not always so. Tenderness on both the right and left side may make one suspicious of tubal disease. We have found that our most reliable aid is the sedimentation time, and it should never be neglected. We agree entirely with the work of Lesser and Goldberger<sup>1</sup> who state that in cases of acute appendicitis, "in which, despite a definitely high leucocytic count, at operation such pathological states as catarrhal, suppurative, or gangrenous appendicitis were demonstrated, there was no deviation from the normal sedimentation reaction." The only forms of appendiceal pathology giving abnormal sedimentation reaction were those of well established abscess or generalized peritonitis of appendiceal origin. On the contrary, in acute adnexal disease the sedimentation time is markedly hastened.

I have also appended the histories of 2 cases of bleeding from an ovarian follicle, in which the possible diagnosis of pelvic appendicitis was considered. The symptoms may be very similar. Bladder or rectal irritation and pain on rectal examination are usually present. The variability in signs and symptoms on examination at different times is rather characteristic of this condition. Because of this variability, we have usually hospitalized such patients for observation, and again, if one remembers the not too uncommon occurrence of bleeding from ovarian follicles, diagnosis can often be ventured. Patients react differently to free blood in the

peritoneal cavity. There are those in whom it causes a great deal of pain, with a high leucocyte count up to 35,000, in others these are not so marked. Bleeding, which comes usually from a pin-point area on the ovary, occurs from time to time, and symptoms are present only during the bleeding. This accounts for their variability. Ruptures seem usually to occur at or near the menstrual period. As said before, we believe that this condition is not very uncommon, that it occurs more often than we know, and is the cause of pain in the right or left quadrants in young women, suggestive of appendicitis, which clears up when bleeding has ceased. Not all the cases go on to massive hemorrhage, as has been found in our operative cases.

Stone in the ureter can be very misleading. We recently made a mistake on such a case. The pain of ureteral colic is usually more severe and demands a hypodermic, as it seldom does in appendicitis. This might give one the necessary clue. Also, the red blood cells in the urine are usually greater in number and more persistent. On suspicion, roentgen-ray studies should be made.

In the treatment of pelvic appendicitis, when this diagnosis is definitely made, it is customary for us to advise a right rectus incision, whereas ordinarily we definitely favor the McBurney incision for acute appendicitis, and furthermore, if rupture seems probable, as is often the case in this form of appendicitis, we believe that spinal anesthesia has great advantages. We feel quite sure that there is an added danger in removing an adherent or gangrenous appendix lying in the pelvis through a McBurney incision, even when the latter has been extended. We seldom, if ever, drain the peritoneal cavity in acute appendicitis, and in pelvic appendicitis we never drain. We may put small drains down to the peritoneum, but never into the peritoneal cavity. Secondary abscesses may form in the pelvis, but these are always easily opened through the rectum. The presence of drains adds many dangers and increases the mortality.

Let me repeat again that, while it may seem that there is very little to go on in making a diagnosis of pelvic appendicitis, it is our expe-

<sup>1</sup>Lesser, Albert, and Goldberger, Harold A. The blood sedimentation time and its value in the differential diagnosis of acute appendicitis. Surg., Gynec. & Obst. 1935 60 157

rience that once one makes of this disease a mental and diagnostic entity there will always be one or more clues at hand upon which a careful clinician can base a diagnosis.

At the present time there has been a very considerable effort to lower the mortality statistics of appendicitis and emphasis has been laid on many factors which have helped. Everyone states however that no real advance can be made except through early diagnosis. It is axiomatic that when perforation occurs the death rate rises and—if my experience coincides with that of other surgeons—pelvic appendicitis ruptures more frequently than any other form because of delay in diagnosis. Therefore the early diagnosis of acute pelvic appendicitis with prompt operation will be the method par excellence of reducing the death rate.

#### CASE REPORTS

##### *Pelvic appendicitis in rupture*

Mr. W. male aged 53 years rather stout and plethoric. Previous operations infected plonidal cyst 1921 recurrent left inguinal hernia 1928 followed by pulmonary infarct and venous thrombosis of both legs. At this time he had an acute cardiac decompensation. In 1931 he was treated for hypertension. At times he was cyanotic. Blood pressure was about 200. At the time of the present illness however his general condition was much improved.

His symptoms began Friday, November 2, 1934 at 2:00 a.m. He was waked out of sleep by severe abdominal pain cramp like in character. He walked about the room unable to get comfortable. His physician in the morning found him without fever with a pulse of 70 abdomen soft throughout with no pain even upon the deepest pressure. The patient stated that he had had a desire to defecate and went several times to stool without result. A laxative had been taken an hour before the doctor called. A diagnosis of possible appendicitis was made but there was considerable doubt in the physician's mind. However a nurse was sent to his hotel in order to avoid any mistake. At noon there was still no fever but the patient was still in pain.

The following day the pain continued. Temperature was 99.2 degrees. Examination at this time disclosed no change in the physical signs but there was still pain in the lower abdomen, much more on the left than on the right side. When I saw him later he stated on direct questioning that he had had urinary symptoms at the end of the penis and a desire to urinate.

There were then on Friday the triad of symptoms which should have led to operation. Sudden severe pain on the left side more than on the

right urinary and rectal distress and an absence of all tenderness and rigidity. Unfortunately, no blood count was taken until the next morning at which time there were 20,400 leucocytes.

Isa this patient first in consultation at 6:00 p.m. on Saturday November 3. Definite signs of rupture had by this time taken place. The entire lower abdomen was rigid on both sides tense and tender. There was dullness over the symphysis extending both to the right and left sides. The pains were not so severe as they had been and he did not look sick. Temperature was 100 degrees. The leucocyte count was 26,500 polymorphonuclears 85 per cent. He was a fat man and rectal examination was not satisfactory but was lightly confirmatory. Pelvic appendicitis with rupture was diagnosed and he was immediately hospitalized.

Operation. Right rectus incision. The appendix lay over the brim of the pelvis behind the bladder. The head of the cecum was bound down in the pelvis and could not be elevated. When the peritoneal cavity was opened thin pus was withdrawn with an aspirator and became thicker as we came nearer to the appendix. The appendix was covered with fibrin and was necrotic and surrounded by thick creamy pus. There was no odor to the pus.

Smears from the peritoneal cavity showed no colon bacilli but streptococci. Cultures later showed colon bacilli streptococci and staphylococci.

The next morning the patient was much better remarked that he had great relief from pain. It seemed comfortable. In the afternoon however vomiting became severe with great distress. Toward evening he became cyanotic and died at 1:00 a.m.

This man was a poor subject for any kind of peritonitis and especially streptococcal peritonitis. He had marked cardiovascular disease high blood pressure and was very stout. He had however early in his disease the typical symptoms of pelvic appendicitis as we have drawn them.

##### *Pelvic appendicitis in rupture*

F. N. male aged 40 years business executive. Physically he was perfectly well on December 8, 1934 on rising. He had his usual bowel movement after a light breakfast. During the morning at the office he developed a dull nagging pain in the midline above the umbilicus. The pain persisted steadily although varying in intensity. He tried an alkaline powder vomited twice with considerable retching, small amounts of watery fluid. His bowels moved twice—small amounts. He had some urinary distress and a little urinate at the end of the penis. The pain persisted so that at 2:00 p.m. by his physician and at that time he complained of a steady moderate pain just below the umbilicus spreading laterally. He was comforted by strong

local pressure. There was no rigidity, the abdomen was soft.

Temperature, 98.6 degrees, pulse, 94. General examination was negative. On abdominal examination his muscle wall was well relaxed everywhere. There was no tenderness over the area of indurated pain. There was some slight sensitiveness to light pressure in the area above the symphysis, extending about an inch to the right and 2 to 3 inches to the left. Peristalsis was present. No blood count was taken, probably, because of the absence of rigidity.

At 6:00 p.m. he reported no change except a temperature of 99.6 degrees. He had vomited once in the afternoon. During the night his temperature rose to 101 degrees. He had considerable pain, and vomited once or twice, and soreness was now present across the lower abdomen. At 10:30 in the morning of December 9, about 24 hours after the onset, he was seen by a surgeon. At that time his temperature was normal, pulse was not rapid, and there was only questionable rigidity in the left lower quadrant. The blood count at noon was white blood cells, 22,000, and 80 per cent polymorphonuclears. At 1:00 the temperature was 100.5 degrees, pulse 96, and he again had pain across the upper abdomen, cramp like. His abdomen was relaxed, there was no rigidity. There was noted sensitiveness to pressure above the symphysis and running to the left.

I saw this patient at 6:00 p.m., with a temperature of 99.5 degrees, pulse, 101. The patient was bright, active, and said he felt better than at any time since the onset. He thought he might be able to go to the office in the morning. All his upper abdominal pain had gone. Sensation of lower abdominal pain was almost gone. He was not nauseated.

When I examined him, however, there was tenderness and resistance on the right side, and on rectal examination he was found to be definitely tender on the right side, and one could feel guarding of the muscles rectally. The medical attendant who made rectal examination was not able to verify this, but I felt sure that there was definite resistance and greater tenderness on the right side.

It was difficult to persuade both the patient and the doctor in charge that operation was necessary, and that, immediately. A diagnosis was made of pelvic appendicitis with probable rupture. On his entrance into the hospital, the physician in charge even delayed the operative procedures until I should see the patient again, thinking that operation might not be necessary, and told the family that if the blood count was lower he would advise delay. Fortunately, the blood count at the hospital was 27,940 white blood cells with 89 per cent polymorphonuclears (filamented neutrophils 69 per cent, non-filamented 31 per cent). It was not difficult, therefore, for me to persuade the physician that operation was essential at the time. I am sure, however, that if the blood count had been around 12,000 to 14,000, it would have been difficult to persuade him that the patient was not getting well, and such a count is possible.

A right rectus incision was therefore made for a pelvic appendix. Immediately the peritoneum was opened, free thin purulent fluid was present, which spilled over the wound. As we wiped off the ileum on one side, and the cecum on the other, deep in the pelvis lay a red fibrous appendix attached to the terminal ileum by a broad band. The end of the appendix was necrotic and contained a small perforation. The peritoneal fluid became thicker as we neared the appendiceal area.

The appendix was removed the usual way, and the wound closed, the peritoneum being sewed with a double layer of catgut and the skin and fascia by a figure of eight mattress or silk worm gut, with rubber drains down to the muscle between each stitch.

This patient made a perfect recovery. The wound healed without suppuration except for a little serum discharged on the fourteenth day, and patient was discharged from the hospital with a strong abdominal wall.

#### *Pelvic appendicitis with rupture*

I G., male, age 12½ years. On Saturday, February 2, 1935, he was indiscreet in his diet, and Saturday night had abdominal pain for which laxative was given. On Sunday, February 3, he was awakened with severe abdominal pain and vomiting.

On the following day, Monday, February 4, his physician was called, and he was found to have a temperature of 100.4 degrees, 17,000 leucocytes, and 79 per cent polymorphonuclears. There had been no further vomiting. On examination, there was no rigidity. His abdomen was perfectly soft throughout, but he complained of some urinary frequency. No rectal examination was made.

On February 5, the boy felt perfectly well. He was without pain, but his temperature was 100.4 degrees. On Wednesday, February 6, he felt fairly well. His bowels had moved each day. The doctor felt that he was on the road to recovery.

On February 7, he began to have intermittent pain, and finally abdominal cramps with nausea and vomiting. His temperature rose to 39.8 degrees. His leucocytes, however, were only 11,000, with polymorphonuclears 75 per cent, 68 per cent of which were non-filamented. That evening, on entry into the hospital, his white cells were 8,000, with 70 per cent neutrophils.

At this time, however, we discovered a child in very great pain. His legs were drawn up, he was obviously ill and feverish. His throat was reddened and injected. He was rigid over the entire abdomen, especially in the epigastrium. Rebound tenderness was present. Rectal examination showed great tenderness on the right, with some rigidity.

A diagnosis was made of a perforated pelvic appendix and peritonitis. Therefore a right rectus incision was made. Free purulent fluid was found. Cultures and smears were taken. The appendix lay deep in the pelvis, densely adherent to the sigmoid and freed with difficulty. Several ounces of pus were found around the appendix. The appendix was found to be gangrenous and ruptured.

The patient had a stormy convalescence. Bilateral scrotal abscess formed which had to be opened and drained but no abscess formed in the pelvis which we thought might occur and the patient made a recovery. He was discharged on the twenty ninth day.

This patient had an appendicitis extending over several days the symptoms beginning February 2 operation on February 7. The symptoms were intermittent but I believe diagnosis was possible first by the leucocyte count on the first day the urinary frequency the absence of rigidity. Rectal examination in this case probably would have played considerable part in clinching the diagnosis. The leucocyte count however was misleading later coming down to 11 000 and finally with entry into the hospital to only 8 000.

*Pelvic appendicitis with rupture General peritonitis Deaf*

J. M. Male aged 44 years. This patient was seen in consultation September 25 1935 and gave the following history. He called upon his physician on Friday September 20 stating that he had had abdominal pain. This was first noticed after a rather heavy dinner on September 18 2 days previously. Pain was intermittent mainly in the upper abdomen. For a nights following the onset of the pain he had had very little sleep and ate sparingly. He did not vomit. The bowels acted daily.

On examination at this time Friday September 20 patient had a temperature of 100 degrees pulse 100 and blood pressure 140/80. Throat and lungs were clear and there were normal heart sounds. The abdomen was not distended only slight tenderness on pressure over the entire abdomen. There was no rigidity and no rebound tenderness. Rectal examination did not reveal any masses nor did it cause pain. The prostate was somewhat hypertrophied and smooth.

He was sent to the hospital here with a tentative diagnosis of appendicitis. That evening blood count showed 8 800 leucocytes a 63 per cent polymorphonuclears. The following morning blood count was 8 700 leucocytes with 67 per cent polymorphonuclears. The patient reported that he slept all night no pain had occurred during the night. On examination the abdomen was soft to palpation and not tender. On account of the general and local improvement in his symptoms and the normal blood count a very favorable prognosis was given.

On Saturday September 21 3 days after the onset at 1 30 p.m. the patient had a sudden severe abdominal pain passed into shock and was cyanotic. The blood count at this time was 18 200 leucocytes and 55 per cent polymorphonuclears.

Operation was performed immediately through a right rectus incision. Fetid purulent material escaped

as soon as the peritoneum was opened. The appendix lay in the pelvis adherent to the under surface of the terminal ileum was grayish in color and friable. The appendix was removed and one drain was placed down to the pelvis and another alongside of the cecum. The wound was closed loosely about the drains.

The patient was at first improved then went on to a general peritonitis with foul discharge from the wound. Polyvalent anaerobic serum as given also continuous intravenous drip and hot applications. Distention increased and the patient died at 6 p.m. September 26 of general peritonitis arising from an acute suppurative appendicitis.

This patient was seen in consultation after operation.

Several points in this case should be emphasized. The low blood count the soft abdomen and the absence of rigidity made the diagnosis doubtful and was dependent upon the fact that the appendix lay in the pelvis and was covered by the ileum and was probably difficult to palpate by rectal examination. Repeated rectal examinations however might have been suggestive. This case also brings out the point that when the diagnosis is not made early in these cases it often becomes more difficult as time goes on because of the amelioration of symptoms and then with sudden rupture there is of course no doubt as to the pathology. The suddenness of the rupture in this case with shock and cyanosis suggested the possibility of perforated ulcer to the physician in charge. Attention should also be drawn to the fact that in patients over 40 years of age the prognosis is much worse when general peritonitis occurs than in young adults and children.

*Pelvic appendicitis with rupture*

Mrs. O. T. female married graduate nurse age 24 years. Ltrny December 8 1935. One year ago the patient had an attack of right lower quadrant pain fasting 2 days subsiding with bed rest alone. Six months later she had a similar attack which subsided with a couple of days of bed rest. Her last menstrual period was 3 weeks prior to entry.

Patient entered Ward One at 11 00 p.m. December 8 1935 with the history that she had been perfectly well until Saturday December 7 1935 at which time in the afternoon she developed bilateral lower abdominal pain followed in 3 to 4 hours by nausea and vomiting. She vomited twice. At 10 00 p.m. that night she had a diarrheal consisting of five liquid stools. Bowel movements which continued through the night. The next morning she

felt slightly better, went without breakfast, and returned to the ward to do her work. The abdominal pain persisted in both the right and left lower quadrants, was steady in character, and did not radiate. She had several liquid bowel movements during the day. In the afternoon the pain became so severe that she was forced to go to bed. The pain was constant in character and not intermittent or cramp-like.

On examination at this time, by the medical resident, the patient was found to have a temperature of 100 degrees, pulse, 100, respirations, 22. Heart and lungs were negative. The skin seemed to be slightly icteric. The abdomen was flat, entirely soft. No viscera or masses were palpable. There was tenderness on deep pressure in both the right and left lower quadrants with rebound tenderness in the same areas. Peristalsis was very active. No pelvic or rectal examination was made.

Diagnosis of acute gastroenteritis with complicating catarrhal jaundice was made.

The urine was entirely negative. The red blood cells numbered 4,600,000, hemoglobin was 92 per cent, white blood cells 18,100, polymorphonuclears 91 per cent. Stool sent to the laboratory for culture.

During that night the patient ceased to have any bowel movements and was constipated during the rest of her illness.

On Monday, December 9, 1935, the patient's temperature rose to 103 degrees, pulse to 120. There was slight rigidity in both the right and left lower quadrants, peristalsis was still very active. On rectal examination there was tenderness in both right and left fornices, perhaps a little more tender on the right. She had some discomfort and pain on motion of her cervix.

At 9:00 p.m. on December 9, 1935, bimanual examination was made by Dr. George K. Rhodes. A very tender mass could be palpated in the cul-de-sac. The patient gave a history of two very definite chills, each lasting about 15 minutes, with a profuse perspiration after each. The first chill occurred Sunday afternoon. The second chill occurred at 6:00 p.m. Monday, December 9, 1935, shortly after the first rectal examination. Patient had a very slight burning on urination. A diagnosis of pelvic appendicitis was made.

Operation through a low midline incision revealed a gangrenous ruptured appendix, the tip in the cul-de-sac of Douglas. Purulent fluid was found in the pelvis, and there was considerable peritoneal fluid, cloudy, in the general peritoneal cavity.

The appendiceal mesentery was not remarkable. The appendix was removed, the abdomen was closed with a single Penrose drain placed down to the peritoneum. Good recovery.

In this case the delay in diagnosis was made, first, because of the diarrhea, which was misleading, second, because the resident did not wish to examine the patient vaginally, and

third, because of the misleading sign of a soft abdomen which made the diagnosis of appendicitis improbable. However, it is interesting to know that this patient, in our own hospital, went on to rupture before the diagnosis was made. Our surgical side, however, wishes to point out that the case did not come to their notice until after rupture had occurred and the diagnosis made easy.

*Difficult diagnosis between pelvic appendicitis and salpingitis*

Mrs. I. B., age 23, married. Menstruation always irregular. The last period was 2 weeks ago, lasting 6 days, rather heavy. Has never been pregnant. Has had no discharge. She had been constipated for 5 years, requiring catharsis once or twice a week. Her sleep has been good, but she turns right into day, her husband being a night club operator.

On November 1, 1935, the patient was awakened with violent pains at 3:00 a.m. These pains were across the lower abdomen, as much on the left side as on the right, were cramp-like in character and lasted about 2 hours. At 10:00 a.m., as soon as she got out of bed, the pains recurred as before, across the lower abdomen. She took one teaspoonful of Lysol salts and vomited almost immediately, but repeated the dose and retained it.

The patient remained in bed for the next 4 days without seeing a doctor, the pain being intermittent. On November 3, 3 days after the onset of pain, she had violent cramps in the lower abdomen, as much on the left as on the right.

On November 4, her physician was called at 1:30 p.m. At this time her temperature was 98.6 degrees, pulse rate, 92, respirations, 22. Her white count was 19,500, large monocytes 18 per cent, polymorphonuclears, 78 per cent, eosinophils, 4 per cent, segmented, 70 per cent, stab, 7 per cent, juvenile, 1 per cent, myelocytes, 0 per cent. Urinalysis entirely negative, no red blood cells.

On examination, she was tender to palpation in both lower quadrants, but there was no rigidity and no spasm over any part of the abdomen.

When I saw the patient in consultation, on November 4 at 6:00 p.m., she was sitting in bed looking very well, and she said that she felt very much better. On questioning her she stated that during one day she had had a great deal of irritation and frequency of urination, but this had passed away.

There was no rigidity anywhere, and her tenderness was not very marked even to deep palpation, but was present especially on the right side over the right ovarian region near Poupert's ligament. On flexing the thigh, there was more tenderness on the right side. On vaginal examination, there was a definite fullness and tenderness over the right side, but no masses could be palpated. There was slight tenderness over the left fornix. The uterus could be moved without pain.

## SURGERY GYNECOLOGY AND OBSTETRICS

The differential diagnosis here between an acute pelvic appendicitis and a salpingitis was very difficult. The decision was made mainly on the normal temperature which would be unusual in salpingitis the absence of rigidity also unusual in salpingitis and the sedimentation time which was normal.

Operation was advised which Dr. Daniel Sooy did immediately and he removed a distended gangrenous appendix lying low in the pelvis. The appendix was unruptured. The patient made an uncomplicated recovery.

*Pelvic inflammatory symptoms similar to appendicitis*

*Pelvic sedimentation time diagnostic*  
Mrs. E. C. female aged 46 years married. Hospital entry November 27, 1935. This patient had been operated upon in 1930 for an ovarian cyst. It was not known whether or not the appendix had been removed at this operation. She entered the hospital and gave the following history:

For 4 days prior to entry she had experienced abdominal pain originating in the right lower quadrant radiating to the left quadrant and after 48 hours becoming generalized. The pain was described as being of a sharp shooting character sufficient to make her cry out and to keep her awake at night. There was no associated nausea or constipation. There were no thermometric readings at home and at the hospital the temperature as 38 degrees pulse 84 respirations 18.

Physical examination showed a well developed and nourished woman lying quietly in bed. Complaining however of pain in the lower abdomen. Tenderness to palpation in the right lower quadrant. McBurney's point with marked rebound tenderness. Some guarding in both lower quadrants. Midline incisional scar. No definite rigidity. No tenderness could be felt. Pelvic examination revealed moderate pain on movement of the cervix. Cervix was boggy with yellowish discharge coming from the external os. Hemoglobin was 74 per cent red blood cells 4,400 per cent lymphocytes 12.650 polymorphonuclears 77 per cent (filamented) 18 per cent monocytes 5 per cent (filamented) 70 per cent non filamented 30 per cent.

The house staff felt that this was a case of appendicitis but Dr. Franklin Harris thought that this was more likely a pelvic inflammatory condition. Sedimentation time was therefore done:

6 mm	12/ min
12 mm	21 min
24 mm	45 min

The reading was too rapid for a diagnosis of appendicitis and further suggested pelvic inflammatory disease. However as there was some doubt an exploratory operation was done. The appendix had been removed together with the left ovary and from the right tube was found to be markedly inflamed. The right tube was found at the site of the appendix by dense adhesions. The ovary was

atrophic and not involved. The peritoneal contents were inflamed. The tube was freed from the cecum and the abdomen was closed.

*Diagnosis* Pelvic inflammatory disease acute salpingitis of the right fallopian tube

There was a reasonable doubt in this case between salpingitis and appendicitis but the sedimentation time gave the real differential

*Pelvic appendicitis—diagnosis made* No sed men talion t. n take 1 but would have been valuable

V. H. female aged 27 years. Hospital entry November 14, 1934. She was seen at 3:00 a.m. with a pain about the level of the umbilicus which had begun 4 hours before. It was very severe and extended into the right flank. She had vomited several times. Examination of the abdomen failed to reveal any tenderness or rigidity. Even on deep palpation no pain could be elicited. There was no tenderness in her flank or at the costovertebral angles. There was no peristalsis to auscultation.

This patient gave a history of a similar attack in Boston 8 months before. At that time she was kept in bed and was told that she probably had an appendicitis.

Vaginal examination revealed tenderness behind the uterus. The adnexa were normal. Rectal examination. There was extreme tenderness in the cul de sac. White blood count 25,000 90 per cent polymorphonuclears. On admission to the hospital temperature 37.2 degrees pulse 120 respirations 24.

Dr. Howard Stephens made a diagnosis of pelvic appendicitis and advised immediate operation. A lower right rectus incision was used. In the pelvis a flame appendix was found lying in the pelvis tensely distended. On examination the specimen was found to be acutely inflamed and the lumen filled with pus. No rupture had occurred. The patient was discharged on the ninth day after operation.

This case illustrates an early diagnosis of appendicitis which might have been delayed in other hands for more definite symptoms and which would probably have resulted in rupture. Operation was performed about 6 hours after onset the appendix being already markedly diseased.

*Ruptured ovarian follicle with bleeding into the peritoneal cavity* Previous attacks not operated upon  
Miss B. B. aged 35 years. Hospital entry February 7, 1935. For the past week and a half the patient had had a cold and sore throat. Three days before entry into the hospital she had had low abdominal pain with pain in the rectum on passing stool and this had persisted. The pain in the lower abdomen increased in severity and the day previous to entry she was somewhat nauseated and dizzy.



TABLE I—APPENDICOMILS, MOUNT ZION HOSPITAL, 1922-1934

	Number	Deaths	Per cent
Clinic cases—			
Acute appendicitis including 35 cases of perforation, peritonitis, and abscess formation	211	1	1.9
Subacute appendicitis	131	0	0
Total	342	1	1
Private cases—			
Acute appendicitis including 21 cases of perforation, peritonitis, and abscess formation	745	37	4.9
Subacute appendicitis	721	0	0
Total	1466	37	3.9
Total acute private and clinic cases	1808	38	4.4
Total subacute private and clinic cases	852	0	0
Total	2660	38	1.4

but was able to continue her work as a physiotherapist. Weakness and pain continued until Monday, and she was compelled to go to bed.

Dr Howard Stephens was called. The symptoms were indefinite. She had no rigidity, but there was tenderness more or less generalized over the abdomen. Her temperature was normal. Her hemoglobin was 69.3 per cent, red blood cells, 3,600,000, leucocytes, 12,400, monocytes, 4 per cent, lymphocytes, 8 per cent, polymorphonuclear leucocytes, 87 per cent (filamented, 76 per cent, non-filamented, 24 per cent).

She gave a history at this time of attacks similar to this one about once a year for the past 8 or 10 years, which she stated were indistinguishable from this one. All her previous attacks had occurred around the time of her menstrual period. She had recovered each time without surgical interference.

She was operated on the following day with a low midline incision. She was found to have a ruptured follicle with blood and clots filling the peritoneal cavity. She made an uninterrupted recovery.

Diagnosis here should have been considered, with a low hemoglobin and red count, the weakness and dizziness coming on irregularly, and similar attacks occurring during the time of her previous menstrual periods.

*Ruptured ovarian cyst with hemorrhage into the peritoneal cavity simulating pelvic appendicitis.*

Miss E. G., aged 23 years. Admitted February 8, 1935. She was awakened about 4:00 a.m. on February 8 with a sudden, sharp lower abdominal pain. This pain was soon replaced by a dull ache, which became generalized throughout the lower abdomen. There was no point of marked tenderness. She was nauseated and vomited once.

When examined at 8:00 a.m., she was still complaining of pain. There was very slight tenderness in the lower right quadrant, and some indefinite

TABLE II—SAN FRANCISCO HOSPITAL APPENDICITIS MORTALITY STATISTICS

Type	Description	Cases	Deaths	Per cent
1	Acute, simple	355	3	0.84
2	Gangrenous, non perforated	256	5	1.9
3	Gangrenous perforated	202	18	8.8
4	Appendiceal abscess	187	10	5.3
Total		1000	36	3.6

muscle guarding. No urinary symptoms were present. The patient was in the second day of her menstrual cycle, which was normal in character.

Because of the doubt in diagnosis, the patient was sent into the hospital for observation. During the next 24 hours she continued to have dull aching pain, off and on, sometimes on the right and then it would again shift to the left. Her white blood count fluctuated between 7,000 and 15,000. The patient did not appear to be acutely ill at any time.

Toward evening the patient began to vomit, and this continued from time to time on the following day. At times the abdomen was soft and pliable, at other times it was quite rigid. The temperature was normal throughout the day.

When I saw the patient at 10:30 a.m. on February 9 in consultation with Dr. Groper, the abdomen was flat. There was no active peristalsis, no masses were seen or felt, and palpation revealed a comparatively soft abdomen with some tenderness low down on the right and left sides. Rectal examination did not elicit any pain. The uterus was freely movable. There was very definitely increased tenderness in the right flank. At this time the white blood count was 12,500. Blood pressure 122/70.

Operation was advised, with the probable diagnosis of pelvic appendicitis, but with reservations. A right rectus incision was made by Dr. Groper. On opening the abdominal cavity, it was found to be full of blood, the source of which was evidently a small cyst in the right ovary. This ovary was as large as a mandarin orange, and contained a single large cyst which had ruptured.

I am appending Tables I and II, showing the statistics for appendectomies done at the Mt. Zion Hospital, at which I have the surgical service, and at the San Francisco Hospital, which include cases operated upon both by the University of California and Stanford University surgical services. The latter is a large general hospital where the cases are frequently brought in late, sometimes moribund, and where all of the emergency work of the city of San Francisco is done. I have to thank Dr. Frank Harris for the statistics at the Mt. Zion Hospital. Many of these

patients were operated upon by him and other members of the surgical staff. I also wish to extend my appreciation to Dr. George Rhodes for the statistics at the San Francisco Hospital.

These studies are quoted because in recent years there have been published similar statistics from various clinics throughout the

United States. In some of them the mortality for perforation and peritonitis has been so high that there has been a distinct tendency to advise operative delay in acute cases when the patients come in after the third day. We do not agree with this thesis and still believe that the usual operation should be done when the diagnosis is made.

## INTERVALS BETWEEN PREGNANCIES OF MOTHERS GIVING BIRTH TO CONGENITALLY MALFORMED CHILDREN

A STUDY OF 531 FAMILIES<sup>1</sup>

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IN a previous report, it was shown that the pregnancies which end in miscarriages, stillbirths and premature births—of mothers who bear congenitally malformed children—tend to occur close to the pregnancy which results in the birth of the defective child (1) This finding suggested (a) that at the latter time, these mothers are wont to experience more or less prolonged periods of reproductive inefficiency, and (b) that such intervals of time are sufficiently long to permit more than one conception to take place

The present study also deals with this period of reproductive inefficiency of mothers who give birth to congenitally malformed children It concerns the length of the non-pregnant period which precedes the conception of the malformed child, and is of interest, especially in the light of the findings which resulted from the above mentioned study

## MATERIALS AND METHODS

To quote from a previous communication (2), the material forming the basis for both the present study, and the one mentioned, was secured in the following manner

"There were found in the files of the Bureau of Vital Statistics, Department of Health of the State of Pennsylvania, 130,132 death certificates for stillborn and liveborn individuals who died in Philadelphia during the 5 years between January 1, 1929, and December 31, 1933 Each of these certificates was examined, and the data on those noting the existence of any congenital defect were transcribed to duplicate, official forms, 1,476 such certificates were located

"The deceased individual was considered to have possessed a defect under either of two conditions (1) if the defect involved the surface of the body, or (2), if internal, if its presence had been disclosed by operation or necropsy Diagnoses not conforming to these

requirements were considered as not verified and were excluded from further consideration This procedure reduced the number of usable certificates to 890, or only 60 per cent of the original 1,476 certificates

"An attempt was made to interview the mother of each of the 890 deceased individuals, the visits being made in the summer of 1934 by 3 fourth year medical students, now Drs Dorothea Killian, Tracy Cuttle, and Milton Mazer, assisted by Edward Durkin A complete reproductive history was secured from each mother who could be located The group forms a consecutive series The defective children all died within a given geographic area and in a given period of time"

Among the questions asked the mother of each defective child were the following (a) year and month of marriage, (b) year and month of each delivery, and (c) duration of each prematurely interrupted pregnancy

From the answers to these questions, the lengths of the non-pregnant intervals preceding each conception of these mothers were counted in months In those cases in which a pregnancy was preceded by another pregnancy, the intervening interval was measured from the month of the preceding delivery to the month of the following conception In event of a first pregnancy, the interval was counted from the month of marriage to the month of conception In case the mother married twice and had children by both husbands, the interval for the first child by the second husband was measured from the time of the second marriage

In a few instances, mothers could not give the exact duration of prematurely ending pregnancies In these cases, miscarriages were estimated as having occurred at the end of 3 month periods, and premature births, at the end of 7 month intervals With these facts then, it was possible to determine the

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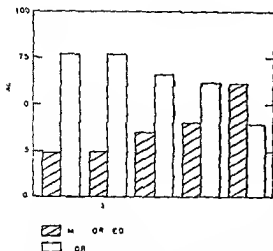


Fig. 1. Graphic presentation of data appearing in columns 4 and 6 Table I. It indicates percentage of pregnancies in this critical time records percent of pregnancies ending in malformations and percent of pregnancies ending in normal births. The hatched bars represent the percentage of pregnancies ending in malformations, and the white bars represent the percentage of pregnancies ending in normal births.

lengths of the non-pregnant intervals in months which preceded the conceptions of both the congenitally malformed offspring and those of their normally developed siblings (brothers and sisters)

#### THE DATA

The lengths of the non-pregnant intervals were determined for 2146 pregnancies which occurred in a consecutive series of 531 families. Of the 2146 pregnancies 584 terminated in the birth of congenitally malformed children and 1562 in the birth of their normally developed brothers and sisters (Table I). The diagnoses of the 584 malformed offspring are given in Table II. In this connection it is of interest to know that the malformations involved the body surface in approximately 80 per cent of cases and that approximately 90 per cent of the malformed individuals died within 1 year of birth.

The number and percentage of pregnancies ending in the birth of congenitally malformed children can be compared with similar figures for their normally developed siblings in Table I arranged according to the lengths of the non-pregnant intervals. The percentage relationship between the two distributions also

TABLE I—NON-PREGNANT INTERVALS BETWEEN PREGNANCIES

Interval months	Pregnancies					
	All	Living				Total
		All malformed		Normal living		
		Total	Per cent of living pregnancies	Total	Per cent of living pregnancies	
Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	
3-4	57	5	3.8	47	7.0	52
5-6	80	6	3.8	3	6.0	9
7-8	29	0	0	5	6.0	5
9-10	5	3	6.0	0	0	3
11-12	6	0	0	0	0	0
13-14	0	0	0	0	0	0
15-16	3	0	0	0	0	0
17-18	0	0	0	0	0	0
Total	156	15	3.8	55	3.8	171

Show distribution of 461 pregnancies for which the non-pregnant interval was 1 to 18 months. The hatched bars represent the percentage of pregnancies ending in malformations, and the white bars represent the percentage of pregnancies ending in normal births. The percentages are based on the total number of pregnancies ending in malformations and normal births.

TABLE II—CLASSIFICATION OF DIAGNOSES

Body	Children	
	Number	Percent
Respiratory	54	9.0
Cardiovascular	5	7.0
Central nervous system	0	0
Musculoskeletal	0	0
Urogenital	0	0
Endocrine	0	0
Total	59	10.0

is expressed graphically in Figure 1. From these data it is apparent (a) that the malformed children had a tendency to be born after longer non-pregnant intervals on the average than were their normally developed brothers and sisters and (b) that an exceed

ingly large number of malformed offspring were born after non-pregnant intervals of more than 4 years' duration

As the home visitors turned in their reports, it was noted that a very long non-pregnant interval frequently preceded the birth of the malformed member of the family. For example, it was quite common in the case of large families to note intervals of 2 to 3 years between normal children and then an interval of 6 or 8 years preceding the birth of the malformed child, followed again by short intervals between subsequent, normally developed children. It was the frequent repetition of this observation which led to the presentation of the figures given here.

The reason why such long, non-pregnant intervals preceded the conceptions of so many of the congenitally malformed children in these families, is not known. A partial explanation for this phenomenon is possible, on the basis of the observations presented in the previous paper (1). As was mentioned there, the parents of congenitally malformed children appear to exhibit a period of reproductive inefficiency, about the time in their reproductive life that they give birth to their malformed children. This period is characterized by the frequent failure of these parents to reproduce full term, living and normally developed offspring. It would seem reasonable to assume, that, during this same period, many

germ cells are produced, which not only are incapable of giving rise to full term, living and normally developed offspring, but also ones which are entirely incapable of becoming fertilized. Hence, although germ cells are produced, they do not become fertilized, and so no offspring appear.

#### SUMMARY AND CONCLUSIONS

1 The lengths of the non-pregnant intervals preceding the conceptions of 2,146 offspring of a series of 531 women, each having a congenitally malformed child, were determined.

2 The non-pregnant intervals preceding the conceptions of 584 congenitally malformed children were found to be significantly longer than the same intervals for their 1,562 normally developed brothers and sisters.

3 This observation, and ones presented in a previous paper, tend to support a theory, to the effect that mothers of congenitally malformed offspring are wont to experience a more or less prolonged period of reproductive inefficiency, at the time that their congenitally malformed offspring are born.

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# THE EFFECTS OF CALCULOUS BILIARY OBSTRUCTION ON THE STRUCTURE AND FUNCTIONS OF THE LIVER<sup>1</sup>

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FROM a theoretical standpoint it would appear that the effects of stone in the common duct on the structure and functions of the liver should be respectively predictable and measurable and that knowing in a given case the duration and relative completeness of biliary obstruction one should be able to estimate the degree of hepatic pathological and physiological change with a fair degree of accuracy.

The facts however seem to be somewhat at variance with this hypothesis if one examines the records of a series of patients with choledocholithiasis it is apparent that there are too many variable factors to allow for an easy solution. Many stones remain latent in the ducts for long periods and cause damage to the biliary system and hepatic parenchyma before producing definite symptoms. It is also known that the ability of the liver to withstand biliary obstruction is by no means constant in different individuals and that the properties of the liver in respect to regeneration and repair vary over a wide range depending on the patency of the biliary system and the maintenance of adequate blood supply. Even if the pathological changes induced in the liver by calculous biliary obstruction were constant which they certainly are not is there any means of determining the presence or measuring the extent of such changes? A completely affirmative reply cannot as yet be given but at least it is possible to obtain considerable information which may serve as a guide to treatment and prognosis.

The pathology of both experimental and clinical biliary obstruction is not a new subject but it is still not well understood nor generally appreciated. For example it is difficult to correlate the gross disease of the liver seen by the surgeon with the microscopic appearance of the organ and the actual extent of destruction of hepatic tissue. Bim-

pies are not an entirely reliable help in this connection since they represent only a small sample of a large organ. There are also certain obvious objections to basing conclusions on necropsy material alone the principal one being that it includes chiefly advanced hepatic lesions. However by a comparison of surgical descriptions with the available microscopic material from all sources it is possible to come to some tentative conclusions in regard to the degree of hepatic damage present in the individual case. This plan is of course subject to criticism but it is reliable in one respect there is little disagreement between pathologists and surgeons as to the nature of the more serious grades of hepatic disease.

In reviewing a series of 63 recent cases of jaundiced patients with stone in the common duct verified surgically or at necropsy and comparing it with a similar series reported in 1932 (10) the pathological lesions appear to fall into 4 groups the first representing uncomplicated calculous obstruction and the 3 remaining the more serious complicating lesions in the liver. These cases may be classified as follows (1) those with minimal gross and microscopic hepatic lesions and only slight evidence of disturbances in the functions of the liver (2) those in which severe ascending biliary infections play a major part in the destruction of the hepatic parenchyma (3) those in which the liver undergoes a process of acute or subacute atrophy and degeneration following obstruction to the duct and (4) those characterized by either advanced hepatitis with beginning fibrosis or by the development of actual cirrhosis.

In the current series (chiefly of cases seen during 1935) the hepatic damage was considered to be slight or moderate in about two thirds of the whole group while in about a third there was gross evidence of marked structural changes. Cases in the first and

largest group, in which only the effects of simple, uncomplicated biliary obstruction are apparent, are chiefly those with a relatively short history of biliary colic and slight transient jaundice at the time of examination. The biliary passages were patent in every instance, and visible jaundice was either slight or in the process of subsiding, the average level of serum bilirubin being about 3 milligrams per 100 cubic centimeters. The surgeon, in describing the gross appearance of the liver as seen at operation, mentioned chiefly the localized perihepatitis in the fossa of the gall bladder and, occasionally, the increased firmness of the liver, its rounded edge, and its indistinct markings. Discoloration from retained bile pigment producing a muddy, brownish hue was sometimes apparent. Not many microscopic preparations from such livers are available, but they show chiefly slight atrophy of the cells about the central veins of the hepatic lobule, scattered bile thrombi, areas of bile pigmentation in the cells in the central zones, and occasional small collections of lymphocytes about the portal spaces. In certain of these cases in which the liver was not remarkable grossly a considerable degree of cirrhosis was already apparent on microscopic study.

In the second group, that in which cholangitis played a dominant rôle, a febrile course, deeper and more persistent jaundice, and intermittent occlusion of the bile passages were characteristic. On the average the serum bilirubin was higher (8 to 15 mgm per 100 c cm) and there was little variation from day to day. Hemorrhagic features and renal insufficiency were common in these cases. The surgical record frequently called attention to the engorged and cloudy appearance of the liver, to the presence of purulent material in the bile ducts, and to the frequent association of pancreatitis. Microscopic preparations in such cases revealed, in addition to the signs of biliary obstruction just mentioned, a greater degree of parenchymal destruction, with leucocytic collections in and about the finer bile passages and portal spaces. Often, abscesses were present, which were most frequently miliary but which were at times of considerable size.

In the third group of cases, which were fortunately not often encountered, the clinical picture was that of icterus gravis following an episode of biliary colic. The distinguishing features of these cases have been described in earlier papers (11), the most striking clinical symptom was the extreme degree of jaundice persisting without particular reference to the patency of the bile passages. The levels of serum bilirubin were high (15 to 20 mgm per 100 c cm), a hemorrhagic tendency was often noted, and hepatic insufficiency was an early development. Since few of the more advanced cases have come to operation, available descriptions of the liver come largely from material at necropsy. The liver was often enlarged, firm, greenish, and showed areas of reddish or yellow mottling, in occasional cases a flabby, friable, atrophic liver was found. Microscopically the picture was that of extensive destruction of hepatic tissue, often whole lobules were destroyed and it was difficult to find anything more than remnants of the normal structure. Extensive fatty degeneration was frequently noted. Some of the less advanced cases of this type were observed at operation, and in these the striking features were the Paris-green color of the liver, its abnormal consistency, the presence of white bile in the ducts, and the difficulty in controlling bleeding.

The fourth group is comprised chiefly of cases in which individuals have for various reasons suffered from intermittent and incomplete biliary obstruction over longer periods of time. Partially patent bile passages, slight constant jaundice, and an enlarged firm liver and spleen are the distinguishing clinical features. Hepatic insufficiency and cholemic bleeding were not as common as might be supposed, and in fact many individuals appear to have an unusual tolerance to obstructive cirrhosis. The liver in numerous cases was described by the operating surgeon as frankly of the hobnail type, perihepatitis and cholangiectasis were common findings, and in a few instances there were even signs of portal obstruction.

Microscopically, the appearance of the hepatic parenchyma in "biliary cirrhosis" was virtually indistinguishable from that in the

ordinary non-obstructive forms. The lobule of the liver were outlined by connective tissue proliferation and there was often distinct adenomatous formation with gross disorganization of the hepatic structure. Bile staining of the hepatic cells, dilatation of the intrahepatic bile passages and patchy areas of atrophy were usual accompaniments of the process. In some cases by appropriate stains fairly extensive deposits of fat were shown.

It should not be inferred that these four groups are absolutely distinct and characteristic as a matter of fact combination forms are noted commonly both in the more chronic and severe cases and in some of the supposedly uncomplicated cases in which the cirrhotic process was occasionally well under way. Suppurative cholangitis or acute degenerating hepatitis may supervene in any type of biliary obstruction without respect to its duration or the previous condition of the liver. Cholangiectasis may also be a factor particularly in association with large impacted stones or following repeated episodes of partial obstruction but it is of much less importance than in cases of biliary obstruction from neoplasm. The time factor in the development of secondary hepatic lesions is important while one sees extensive acute or subacute degenerating lesions at any stage of biliary obstruction the actual gross appearance of cirrhosis was uncommon except following long continued interference with the flow of bile.

From the pathological standpoint one may conclude that in about two thirds of cases of calculous biliary obstruction the hepatic lesions are of a relatively minor and temporary nature and of such a character as to present no great obstacles to recovery in the remaining third more serious complicating lesions are encountered which are characterized by various degrees of degenerative or destructive lesions in the hepatic parenchyma by proliferation of connective tissue and cirrhosis by cholangiectasis and cholangitis or by combinations of all three. These pathological changes are reflected to a considerable degree in disturbances in function which may be demonstrated in various ways and as a rule one may form certain conclusions as to the

probable degree of hepatic damage from such tests. As a general rule the three more serious types of hepatic damage just mentioned can not always be clearly distinguished one from the other by clinical or laboratory means and in discussing the effects of these lesions on hepatic functional tests they are best considered as a group.

In the first and larger group of patients who present the picture of uncomplicated temporary biliary obstruction and who are usually classified by the operating surgeon as having minor grades of hepatitis (grade 2 or less) the only hepatic functions which are particularly affected are those that control the excretion of bilirubin and such dyes as bromsulphalein. As stated in an earlier paragraph the average level of serum bilirubin in this group of cases at the time of operation was about 3 milligrams per 100 cubic centimeters. In a few cases seen immediately following colic a peak of 6 to 8 milligrams per 100 cubic centimeters was attained but within a day or so a much lower figure was recorded. In a number of such cases the retention of bromsulphalein was graded 1 to 3 especially when the test was performed shortly following colic. Since it is known (1) that the hepatic cell takes up dyes poorly during or immediately following an episode of biliary obstruction this finding is of little importance and does not signify hepatic damage of the degree indicated. Occasionally a positive Takata-Ara test was noted this also can be distorted to a great extent since the test is not by any means a specific indication of the presence of cirrhosis (4) as some writers have intimated. In other words a low figure for serum bilirubin following an isolated recent attack of biliary colic is of itself reasonably good assurance of a hepatic parenchyma that is to all intents and purposes competent at that particular time. Under these circumstances further hepatic functional studies are not likely to give much additional information of value. An exception must be made in the cases of patients who give a long history of repeated colic and slight variable icterus since in these cases there may be chronic hepatic damage of considerable extent in spite of a minor degree of bilirubinemia.



In the three groups in which more serious hepatic damage is present, such damage is, as has been said previously, traceable to cholangitis to extensive degenerative hepatitis, to the development of biliary cirrhosis and, rarely, to interference with the portal blood supply. In these cases the widest possible range of disturbance in hepatic function has been recorded, and to avoid confusion the results are best evaluated by considering the individual functions themselves. The general metabolic properties of the liver are not as a rule greatly disturbed even by destruction of a considerable portion of its parenchyma, the assimilation and utilization of carbohydrate, protein, and fat being maintained within physiological limits. The only disturbances of carbohydrate metabolism which are of importance are two: (1) there may be an increased excretion of galactose in the occasional case with acute cellular damage, and (2) hypoglycemia may occur among patients with extremely fatty, cirrhotic livers. The only significant changes in protein metabolism are those pertaining to the level of plasma proteins, a matter which will be considered separately, a low value for blood urea is uncommon and only rarely have studies on the partition of urinary nitrogen shown significant variations from normal (13). The relation of the liver to fat metabolism is virtually an unexplored field. It is known that biliary obstruction even if of fairly short duration, will produce a marked rise in blood cholesterol and cholesterol esters and, conversely, that progressive hepatic damage will result in an equally striking fall of these substances, in cases of acute or subacute atrophy of the liver the cholesterol esters may be reduced to extremely low levels. None of the foregoing changes are of clinical importance and can rarely be used as a guide to prognosis.

For practical purposes the most valuable information on the state of the hepatic parenchyma of the patient with calculous obstruction may be obtained from three sources, namely studies of the excretory functions, of the detoxifying functions, and of the "manufacturing" functions of the liver. The first implies principally a consideration of the levels of serum bilirubin and their fluctua-

tion. It has long been a rule of thumb that deep jaundice following biliary colic meant a badly damaged liver. For instance, in the series of cases under consideration, every patient who had a level of serum bilirubin maintained at 8 milligrams per 100 cubic centimeters or higher had gross visible hepatic damage of considerable degree at operation. In the individual case it is difficult to say just how much of this rise in bilirubin represents obstruction of the bile ducts alone and how much represents the damming back of normally formed bilirubin because of damage to the hepatic cells themselves. It is rare that the common duct is completely occluded by stone, so that the high levels for serum bilirubin cannot be explained on this basis. There is some indirect evidence, based on photometer determinations of bilirubin (7), which indicates that bilirubinemia due to obstruction alone rarely exceeds 5 to 8 milligrams and that any increment above this is due to failure of bilirubin (giving the indirect van den Bergh reaction) to pass the hepatic cell. In other words, increases above the average level for uncomplicated obstruction furnish an index of hepatic damage.

The studies of Watson on the excretion of urobilinogen furnish an interesting corollary to this theory, he has shown that in uncomplicated cholelithiasis the urinary excretion of urobilinogen is within normal limits, whereas in cases with associated cholangitis or cirrhosis the liver fails to take up the chromogen, and it is eliminated in large quantities in the urine. Whatever the explanation of the increase in serum bilirubin in complicated cases of common duct stone may be, there is no disagreement as to its significance. In this field theory and practice agree, the mortality of surgery in cases of calculous biliary obstruction lies largely, as one could predict, in the group of deeply jaundiced patients.

Among the most useful of the hepatic functional tests from the standpoint of prognosis is one which is based on the detoxifying ability of the liver, specifically on its ability to conjugate benzoic acid with glycine and thus form hippuric acid. In man, the site of this synthesis is presumed to be the liver, and the

excretion of hippuric acid has therefore been taken as a measure of hepatic function. Because of the necessity of being certain that the hippuric acid is eliminated at a normal rate by the kidney the test cannot be relied on unless renal function is approximately normal. Positive tests (an excretion of less than 3 grams of hippuric acid during a period of 4 hours after a test dose of 6 grams of sodium benzoate has been administered) are an excellent indication of a damaged liver and in a fair number of cases we at the clinic have noted as have also Quick and Vaccaro that there is a rough inverse quantitative relationship between the degree of hepatic damage and the amount of hippuric acid synthesized. The test is not infallible and both positive and negative errors have been recorded; however it may be said that if the elimination of hippuric acid is reduced to 50 per cent or less the operating surgeon almost invariably finds a badly damaged liver with evidence of acute or subacute hepatitis and cirrhosis. Here again there is agreement between the theoretical and the practical: the mortality figures in a small group of cases seem to bear out the contention that a strongly positive hippuric acid test indicates a grave surgical risk.

Other hepatic functional studies which give information of value with regard to the state of the hepatic parenchyma following calculus obstruction are those which pertain to the formation of blood proteins. All four of the blood proteins—fibrinogen, hemoglobin, serum albumin and serum globulin—have been studied in connection with hepatic injury. Fibrinogen is known to be an exclusive hepatic product and low values have been encountered in hepatic disease but since infection or injury to tissue have been found to increase the amount of fibrinogen in circulation the determination of this substance has been of little value for diagnostic purposes. The relation of the liver to hemoglobin formation and function is a newer and more promising field. It has recently been shown by Whipple and his collaborators that the liver participates in active fashion in the preparation of parent substances for hemoglobin production and the same investigators (9) have

demonstrated by biologic assay that there is a great reduction in the factors which produce hemoglobin in certain types of diseased livers. This was true particularly if hepatic insufficiency was present before death. These findings seem to indicate that hepatic disease interferes with the production of hemoglobin which is in accord with the well known macrocytic anemia of portal cirrhosis. At the clinic we have repeatedly noted that in the presence of stone in the common duct and secondary biliary cirrhosis macrocytic anemia to a considerable degree may be present and that its presence is indicative of advanced parenchymal destruction.

We have recently been concerned with the occurrence of anoxemia in hepatic disease (12) and since there are no cardiorespiratory factors to explain it adequately the question was naturally raised as to whether the hemoglobin is altered qualitatively as well as quantitatively by hepatic injury. While the results of the investigation thus far are not conclusive it seems possible that under certain conditions this may be the case. In 3 cases of stone in the common duct and associated parenchymatous hepatic injury it was noted that anoxic anoxemia was present and that in one case the hemoglobin did not become completely saturated with oxygen in the usual manner either *in vivo* or *in vitro*. The dissociation curve of oxyhemoglobin obtained in this case was distinctly abnormal thus suggesting that hemoglobin sometimes may be functionally altered in respect to its ability to transport oxygen in the presence of hepatic disease. The presence of an active reducing agent in the blood of such patients has not been excluded.

Variations in the serum proteins—albumin and globulin—have been noted for some time in the presence of hepatic disease and the relation of such variations to hepatic functional disturbances rests on a sound experimental and clinical basis. While there is no direct proof that the liver is the sole site of manufacture of serum proteins experimental studies furnish some indirect evidence of their hepatic origin. Recent work in Whipple's (2, 3) laboratory indicates that there is a reserve of protein building material in the

TABLE I—HEPATIC FUNCTIONAL TESTS IN VARIOUS TYPES OF OBSTRUCTIVE JAUNDICE

Patient	Hemo. h'm gm per 100 c.c.m.	Prothro. c.c.e. in 3 hours	Serum bilirubin m.m. per 100 c.c.m.	Serum bile salts, m. per 100 c.c.m.	Alb. globulin ratio	Calc. of retention, $\mu$ m	Calc. of excretion, $\mu$ m	Calc. of excretion, m. per 100 c.c.m.	Calc. of excretion, m. per 100 c.c.m.	Takata Astra test	Hippuric acid $\mu$ m	Arterial oxygen saturation per cent	Plasma coagulation index	Hepatic changes (surgical note)	Outcome
Bo	12.3	3.5	13.2	7.0	1:1.4	1.3	7.5	115						Moderate hepatitis, good bile in common duct	Recovered
Ma	13.3	4.10*	5.3	7.0	1:3.2		315				2		10	Moderate cholangitis	Recovered
Ti	9.9	3.69	5.1	5.55	1:0.1	Neg.	755	410		Pos.	4.10		0.3 to 0.55	Hard bile like liver and hepatitis	Recovered
G*	14.4	4.11	11.1	6.11	1:1.1	Tr				Pos.	1.70	57.5		Hepatitis grade 4+	Recovered. Much residual hepatic damage
Hrd	11.1	3.04	5.0	6.3	1:1.32		211	75		Pos.	0.45			"Hobnail liver"	Recovered
Li	9.6	3.41*	7.9	7.1	1:1.3	1.23	410	152			3.62	53.4		Cirrhosis grade 2+	Previous stricture and stones in duct died

\*Miscellaneous.

organism which is stored, at least in part, in the liver and which is probably at least 50 per cent albumin or albumin producing material, and these investigators believed that there is probably a dynamic equilibrium between tissue and plasma protein, in which equilibrium the stored material in the liver may figure.

There is a long series of reports on the relation of hepatic disease to the level of serum protein (5), and it has been observed repeatedly that in advanced chronic hepatic lesions, particularly in portal cirrhosis, there is a moderate reduction in the total serum proteins, the diminution occurring chiefly in the albumin fraction with reversal of the albumin-globulin ratio. In less advanced cases, the albumin may be only moderately reduced and the globulin may be normal or increased in amount. In any type of hepatic disease, however, the effects on the albumin-globulin ratio are somewhat the same. In some cases of hepatic damage due to stone in the common duct studied at the clinic, albumin-globulin ratios as low as 0.5 have been observed. In others, with less serious hepatic injury, the changes in the ratio are not as marked or constant and the variations noted tend to return to normal as improvement takes place. The rapidity with which changes

in the total serum protein and in the albumin-globulin ratio may take place is rather striking, and repeated determinations in the same case and in experimental studies on animals indicate that these changes reflect in a general way the course of the hepatic lesion. In clinical subjects it has been noted that very low albumin-globulin ratios are found only in cases in which obstruction of the common duct has seriously damaged the hepatic parenchyma, and for this reason it appears that determinations of the serum proteins and the albumin-globulin ratio may be of considerable value in prognosis. In this connection it should be noted that the development of ascites in the occasional case of biliary cirrhosis may depend on reductions in serum albumin, the factor shown to be most important in maintaining the osmotic pressure of serum.

The extent to which the results of the various hepatic functional tests can be correlated one with the other and with the degree of hepatic damage described by the operating surgeon is shown in Table I. It is apparent that the deviations from normal as determined by the various methods of study do not necessarily parallel one another, but that on the whole this situation is approached in the more chronic and severe hepatic lesions. The

greatest and most constant abnormalities are noted in patients with obstructive cirrhosis and in this group the danger signals of hepatic dysfunction are easily recognized. In such cases the pathological and physiological findings are in accord in the acute degenerative forms of hepatitis and in ascending biliary infections the most constant evidence of progressive destruction of hepatic tissue is the high and constant bilirubinemia.

In neither the acute or chronic forms of hepatitis secondary to calculous obstruction are there any hepatic functional tests which accurately foretell the tendency to cholemic catastrophe being given by Nygaard's method of determining the index of plasma coagulability. What makes the jaundiced patient bleed or what the basis of hepatic insufficiency may be are the two questions which every surgeon would like to have answered. There is no clue as yet which promises an immediate solution to either problem and speculation on the subject is hardly warranted. That the two phenomena are closely allied can hardly be doubted; they may depend on the liberation of some substance from degenerating hepatic tissue or on some as yet undiscovered abnormality in the physicochemical properties of blood induced by hepatic damage. Until these two major problems in the field of biliary surgery are settled studies in the pathology and physiology of hepatic disease should not be abandoned.

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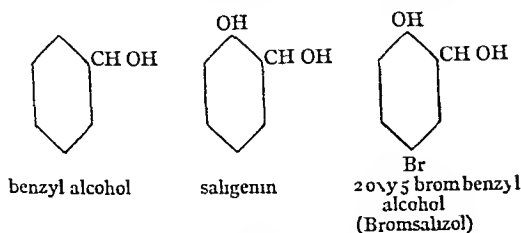
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# A THERAPEUTIC STUDY OF BROMSALIZOL IN CHRONIC ARTHRITIS

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**B**ROMSALIZOL, or mono-brom saligenin, is a chemical compound described by Macht and Dunning in several previous communications (3, 4, 5, 6, 7) Pharmacological study of this drug revealed that it possessed two striking physiological properties (1) a local anesthetic effect and (2) an antispasmodic action on smooth muscle tissues and organs It was furthermore discovered that the toxicity of bromsalizol was very low, another finding which warranted its therapeutic trial Such a study, undertaken by a number of physicians, indicated that the drug was effective in clinical conditions characterized by colic-like pains and other symptoms produced by spastic condition of smooth muscle tissues These cases included particularly such diseases of the gastro-intestinal tract as pyloric spasm, spastic conditions of the small and large intestine and gall-bladder colic, dysmenorrhea or colic due to spasm of the uterus, and a number of urological conditions, especially spasm of the bladder, seminal vesicles, and ureters (8) Later reports from numerous physicians in various parts of the country confirmed the original findings

The chemical structure of this compound is shown below Bromsalizol is mono-brom saligenin, a derivative of saligenin or hydroxy benzyl alcohol Saligenin is found in nature in the glucoside known as salicin, which was used by the old physicians in



treating rheumatic affections (1) The compound is closely related to salicylic acid, as a comparison of the formulas given will show

Because of the therapeutic value of the salicylates and of salicin as antirheumatics, it was deemed worth while to conduct an investigation for the purpose of determining whether or not bromsalizol afforded any relief in arthritic cases

## ANIMAL EXPERIMENTS

It is not possible to produce an arthritis experimentally, neither is it possible to make an accurate comparison of such pain relieving drugs as the various antipyretics by the use of animals In the pharmacological laboratory, however, we could and did obtain indirect experimental evidence indicating that bromsalizol exerts on the central nervous system an action very similar to that of the salicylates and other antirheumatic drugs Such indirect evidence was derived from experiments on animals with fever, animals with convulsions of cerebral origin, and animals with general anesthesia

Fever was produced in rabbits and guinea pigs by various methods as, for instance, by injecting them with hay infusion The action of bromsalizol, administered by stomach to these experimental animals, was then investigated It was found that bromsalizol, like the salicylates and other antispasmodic drugs, produced a definite, though not very marked, lowering of the temperature This finding is illustrated by the following protocols

*Rabbit No 17*, weighing 2 kilograms, previously injected with hay infusion

11 18 a m Temperature, 10.4 degrees F

11 25 a m Injected intraperitoneally 20 cubic centimeters (100 milligrams) of 0.5 per cent solution of saligenin

12 20 p m Temperature, 10.4 degrees F

2 00 p m Temperature, 10.4 degrees F No antipyretic effect

*Rabbit No 18*, weighing 2 kilo, previously injected with hay infusion

11 20 a m Temperature, 10.4 degrees F

11 25 a m Injected intraperitoneally 15 cubic centimeters of 0.5 per cent solution of bromsalizol

12 20 p m Temperature, 10.0 degrees F

1 00 p m Temperature, 10.1 degrees F

2 00 p m. Temperature 104 degrees Anti  
pyretic effect and recovery  
*Guinea pig No 1* weighing 420 grams previously  
injected with hay infusion  
2 00 p m Temperature 103.3 degrees F  
2 05 p m Injected intraperitoneally 50 milligrams  
of saligenin  
3 00 p m Temperature 103 degrees F  
*Guinea pig No 2* weighing 440 grams previously  
injected with hay infusion  
2 10 p m Temperature 104 degrees F  
2 15 p m Injected intraperitoneally 50 milligrams  
of bromsalizol  
3 00 p m Temperature 102.8 degrees F  
Antipyretic effect

3 08 p m Tremor  
3 10 p m Mild convulsion  
3 20 p m. Sitting up no convul ion  
4 00 p m Mild convulsion  
4 15 p m Quiet  
Next day Recovered

The antipyretic effect of bromsalizol could be demonstrated only in animals with hyperpyrexia or temperature above normal. The temperature of normal rabbits could not be lowered to a subnormal degree even by doses of 10 grains administered by stomach.

A second series of experiments gave further proof that bromsalizol exerts a mild sedative action on the central nervous system. In these experiments convulsions of the cerebral type were produced by injecting guinea pigs, rats and mice with solutions of camphorated oil and a study was made to determine whether or not bromsalizol antagonized such convulsant action. The effect of bromsalizol or mono brom saligenin on camphor convulsions was compared with that of the mother substance saligenin itself. It was found that saligenin alone exerted very little antagonistic action on the convulsions but that bromsalizol had a definitely sedative and anticonvulsant effect. This action is illustrated by the following protocols:

*Guinea pig No 3* weighing 420 grams  
9 55 a m Injected intraperitoneally with 50 milligrams of saligenin  
2 25 p m Injected intraperitoneally with 50 milligrams of saligenin  
2 57 p m Injected 1 cubic centimeter of camphorated oil (U S P)  
3 03 p m Violent convulsions  
3 20 p m Repeated clonic and tonic convulsions  
3 30 p m Moribund  
4 15 p m Dead  
*Guinea pig No 4* weighing 430 grams  
9 58 a m Injected intraperitoneally with 50 milligrams of mono-brom saligenin (bromsalizol)  
2 30 p m Injected with 50 milligrams of bromsalizol  
3 00 p m Injected with 1 cubic centimeter of camphorated oil (U S P)

Further evidence of the sedative effect of bromsalizol on the central nervous system and particularly on the brain was obtained in experiments on such small animals as rats and mice. Large doses of bromsalizol injected in these animals produced a hypnotic effect. Having thus been put to sleep they remained anesthetized for many hours. If the dose was not excessive they eventually regained consciousness and were apparently in sound health a few days later.

*Rat* weighing 150 grams Injected intraperitoneally with 10 cubic centimeters of 0.5 per cent solution of mono-brom saligenin (bromsalizol) in physiological saline. Hypnotic effect produced recovery in 3 hours.

*Mouse* weighing 24 grams Injected intraperitoneally with 1 cubic centimeter of 0.5 per cent solution of bromsalizol. Deep anesthesia partial recovery in 6 hours complete recovery overnight.

Such a general anesthesia could not be obtained in experiments on larger animals—guinea pigs, pigeons, rabbits, cats and dogs—even with very large doses of the drug. Nevertheless the experiments on small animals indicated that bromsalizol has a sedative effect on the brain including the pain areas.

#### THERAPEUTIC EXPERIENCES

Inasmuch as the salicylates and salicin have proved efficacious in relieving rheumatic or arthritic pains and the experiments with bromsalizol described indicated that in some respects it has on the central nervous system an action like that of the salicylates, it was deemed worth while to make a study of this drug on a series of clinical cases especially since it has a very low toxicity. Such a study was made on a series of clinical cases suffering from arthritic pains of a chronic type and the effect of bromsalizol on such patients was compared with that of acetyl salicylic acid and various other antipyretics.

Doses of from 5 to 10 grains of bromsalizol were administered three times a day to each of a series of one hundred ambulant cases

complaining of arthritis. More than 75 per cent of these patients were definitely relieved of their rheumatic pains, and a comparison of the action of bromsalizol with that of acetyl salicylic acid revealed that the stomachs of these patients tolerated the former better than the latter. Indeed, some of the patients selected for this study took bromsalizol because they had suffered gastric irritation from previous administration of ordinary salicylates. Data regarding the ambulant cases mentioned have been obtained from a number of practicing physicians. A detailed description of this series of cases is omitted because the object of the present paper is primarily to set forth the results obtained in a carefully controlled study of the effects of bromsalizol on chronic arthritis under the constant supervision of doctors and nurses.

Female patients with inveterate arthritic manifestations were selected for this investigation of the effect of bromsalizol on chronic arthritis cases at the Home for Incurables, Baltimore. The action of bromsalizol was carefully compared with that of several other drugs, often without the knowledge of the patient. Bromsalizol was administered in doses of 10 grains three times a day, and sometimes oftener. The drug was usually given in tablet form but in some cases, to distract the attention of the patients, it was administered in capsules. For further control, such capsules were occasionally interchanged with capsules of sodium bicarbonate. Attendant nurses carefully recorded on charts the effect of bromsalizol not only on pain but also on blood pressure, temperature, urine, gastrointestinal tract and general condition and behavior of the subjects.

#### RESULTS

The total number of patients studied was 24, most of them well past middle age. The cases were selected especially for their persistent and uncontrollable arthritic pains. The medication previously employed included all kinds of coal-tar derivatives and also codeine. The effects of such drugs were compared with those of bromsalizol. The results are classified as follows:

No effect was noted in 5 cases out of the 24. The treatment had to be discontinued in other cases because one suffered from a psychosis, a second refused to co-operate and take the drug, a third complained of nausea after its ingestion and a fourth developed a genito-urinary condition from another cause and was accordingly considered unsuitable for such an experimental study. Ten of the remaining cases, or 42 per cent of the total number, were definitely relieved, and 5 patients, or 21 per cent, showed marked relief. A favorable therapeutic action was thus noted in 63 per cent of all the cases.

Another finding made in connection with this study was that the effect of bromsalizol on the temperature was nil except in one case. This patient had a slight fever and bromsalizol lowered the temperature one degree. This negative finding was not surprising because all the other patients had a normal temperature and antipyretics in general, unless they are given in toxic doses, do not lower normal temperatures (2).

It was found, moreover, that bromsalizol had no effect on *normal* blood pressure. In patients suffering from hypertension, however, bromsalizol effected a reduction in both systolic and diastolic pressures. There was an accompanying relief in symptoms due to high blood pressure, such as palpitation of the heart and headache. Thus, for instance, one patient who before treatment showed a systolic pressure of 210 millimeters and a diastolic pressure of 120 millimeters, afterward gave a reading of 160/102. Curiously enough, another patient, whose blood pressure was below normal, or 101/72, before she was treated with bromsalizol, afterward gave a reading of 140/81. This rise in blood pressure was probably due to an improvement in her general condition and relief of her suffering.

With regard to the effects of the drug on the gastro-intestinal tract, it may be noted that one case of constipation, of the spastic type, was strikingly relieved by bromsalizol. This, of course, was a manifestation of the antispasmodic effect of the drug on smooth muscle viscera. The patient's constipation, which was of a decidedly spastic character, was therefore relieved by the drug.

## SURGERY GYNECOLOGY AND OBSTETRICS

## SUMMARY

A clinical study of the effects of bromsalizol or mono brom saligenin on the pains of chronic arthritis in a series of 24 adult and old women revealed that a total of 63 per cent experienced some degree of relief. Twenty-one per cent of these gave evidence of marked relief 42 per cent showed definite but not absolute relief. The action of brom salizol on these patients was compared with that of other antipyretics and in some cases with that of codeine. The relief experienced was equal to that induced by the other medicaments used and in some cases bromsalizol proved to be even more satisfactory than any of the other drugs. Similar results were obtained in a study of a series of ambulant cases. Compared with sodium salicylate and acetyl salicylic acid especially brom salizol produced little or no irritation of the stomach indeed the drug was well tolerated

by patients who could not take either of the other drugs on account of gastric irritation. Such a result was to be expected because of bromsalizol's antispasmodic or sedative action on smooth muscle viscera. No objectionable by effect was noted in any of the series of patients treated with bromsalizol and the authors consider this finding alone sufficient to warrant a more extensive trial of the drug in clinical practice for the relief of arthritic pains especially those of a chronic character.

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A CONSIDERATION OF THE NUTRITIONAL STATUS OF THE SURGICAL PATIENT<sup>1</sup>

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A COMPREHENSIVE analysis of the nutritional status of the surgical patient indicates that many patients at the time of operation are in a state of malnutrition due either to a deficient food intake or to their inability to utilize injected nutritional elements. Such a nutritional disbalance embraces actual food deficiency as well as dehydration, stages of avitaminosis, and mineral deficiency. Under ordinary circumstances the average American, due to comparative accessibility to essential food stuffs, will not display a definite deficiency syndrome unless the period of subtotal starvation is prolonged. However, experience indicates that a considerable number of postoperative complications which increase the patient's discomfort and add to the morbidity, if not to the actual mortality, can be attributed to faulty nutrition.

A study of nutritional status in health and disease is not a simple matter since the body has the ability to compensate for many of the transitory deficiencies of food intake. The situation is amply expressed by McLester: "The organs of the body and the tissues and fluids that make up these organs are in a wonderfully steady state of equilibrium, so much so that when the organism is deprived of anything essential this balance is profoundly disturbed and the entire mechanism upset. To the preservation of this mechanism at all times and in the face of all the vicissitudes to which man is subject many factors contribute, some of these simple in nature, some exceedingly complex, some large, some exquisitely small."

In evaluating the nutritional requirements for the specific individual there must be considered the caloric values of the food elements—protein, fats, and carbohydrates—the essential vitamins, minerals, and water. Water intake so as to assure a complete water balance has been stressed during the past few years and it need only be mentioned here as an

essential in the proper nutrition of the patient. It may not be out of place, however, to mention two phases of water balance as it applies to the surgical patient. One is the insensible water loss. Collier has called attention to this and estimates that the average loss of water during the first 4 hours after a major surgical procedure is 1 liter. This includes loss of blood, urine, evaporation from tidal air, perspiration, and the vomitus. About 70 per cent of this amount is represented by perspiration and tidal air vapor. He states that the amount may be increased to 3000 cubic centimeters by fever. The second phase is concerned with replacement in the event of need of considerable amounts of water. Since the subcutaneous or intravenous methods are the ones usually employed, the water is administered in the form of physiologic salt solution. I have known instances in which 4000 to 6000 cubic centimeters of salt solution have been given during a period of 24 hours. This means that from 36 to 54 grams of salt are given to the patient during a period of 24 hours when the normal need is only approximately 15 grams. In the presence of kidney disease, a crisis may be precipitated by such indiscriminate introduction of salt.

In the consideration of the nutritional status of the individual, the six "pillar aspects" of Sherman are deserving of mention. They are "(1) the energy aspect, (2) the proteins and their amino acids, (3) the mineral elements, (4) the vitamins, (5) the interrelations among these different factors, and (6) the principle that our most significant concern is with the nutritional reactions of the living body as a whole—as a co-ordinated whole which, in some respects at least, is something more than a mere summation of its parts."

The science of nutrition has taught us that the average individual in a state of rest requires 25 calories per kilogram of body weight to supply the necessary energy for his basal metabolism. With activity or when the basal

<sup>1</sup> Read before the Utah State Medical Society at Logan, Utah, September 5, 1933.

metabolism is raised by fever or metabolic disturbances such as may be produced by hyperthyroidism the need materially increases. This energy is supplied by the basal food stuffs—fats, proteins and carbohydrates. By the consumption of these food stuffs when supplied in adequate amounts the body is supplied with the proper amount of fuel for oxidation processes. When excess amounts are taken there is a storage in the form of glycogen deposits in the liver and muscles and deposits of fat. A moderate amount of the latter is desirable since it constitutes a reserve supply of fuel for emergency use and offers protection to organs and structures as well as a mechanical support to organs. The latter is concerned with visceroptosis and allied diseases.

The properly balanced diet should consist of the basal food elements in such proportions as to maintain a normal relationship of essential values. It has been stated that an excess of one type of food with a marked deficiency or absence of another is more harmful than the withdrawal of all food. This applies especially to protein deficiency with a high carbohydrate intake. This observation is especially significant when we consider how often the surgeon attempts to nourish a devitalized patient after operation by giving glucose intravenously. A state of protein deficiency no doubt is an important factor in many surgical patients. The average restricted diet is poor in protein in fact is far below the necessary nitrogenous requirements. Minot is of the opinion that sundry disorders may be attributed to a protein deficient diet. He cites a case in which it is his opinion that the prolonged coagulation time of the blood was due to nutritional deficiency. It is pertinent to note the marked change in the attitude of the internist toward protein intake in forms of nephritis. In the nephroses cases in which large quantities of albumin are lost in the urine it is essential that the protein diet be increased rather than decreased so as to supply the body with sufficient nitrogenous material. Minot believes that in some cases of albuminuria the deficient protein intake may be an etiological factor and that a primary kidney disease is not present the al-

buminuria being the result of a lowered threshold of the kidney associated with defective nutrition. Furthermore it is interesting to note that the modern conception in treating the pregnant woman is because of the inordinate drain upon her body proteins leading to edema and allied conditions toward an increase in the protein diet rather than a curtailment. Protein deficiency manifests itself in sundry ways such as edema, dry, harsh skin, transitory attacks of mild icterus, loss of weight and strength, mental stupor, decreased resistance to disease (McLester) and the like. Just how many of the distressing symptoms encountered in the surgical patient can be accounted for on the basis of protein starvation is yet a question, however it is my impression that protein deficiency plays a much greater rôle in the morbidity and mortality than we believe or can prove.

Carbohydrate food substances are supposed to be readily digested and easily metabolized and therefore are the common constituents of the dietary for a surgical patient. There is no question but that this is true, however they must not be given to the exclusion of proteins and fats. Carbohydrate food stuff supply readily available energy and the excess is stored in the liver and muscles in the form of glycogen. This reserve store of glycogen is not excessive for it is known that with complete withdrawal of carbohydrates and those foods from which the body can build carbohydrates the liver glycogen will be exhausted within 18 hours. After this period of time the necessary carbohydrates must be metabolized from the living body tissues and at the expense of the body economy. It is a growing impression that the extensive and prolonged drainage of the body tissues to make available adequate energy producing elements is detrimental to its integrity. It might be stated that 58 per cent of protein and 10 per cent of fat can be metabolized into carbohydrates in the body, but that protein can not be built from carbohydrates or fats, therefore the necessary proteins must be either supplied extraneously or be withdrawn from the body proteins.

Space will not permit entering into an extensive discussion of the vitamins, how

ever, there is no question but that forms of avitaminosis play a definite rôle in the surgical patient. Perhaps in the average under-nourished patient, a vitamin deficiency plays a greater rôle than actual food deficiency. McLester has noted that in the guinea pig a period of time elapses between the actual exhaustion of the vitamin C reserve and the appearance of scurvy, during which time pathological changes are taking place. He believes that the same situation obtains in man and that there is constant need of a vitamin C supply because without appearance of actual scurvy, changes similar to those in the guinea pig occur which impair resistance for intercurrent infections. In a report of excellently controlled experiments McCarrison concludes that sinusitis, otitis media, gastroduodenal ulceration, forms of goiter, and urinary calculi frequently occur in animals fed an ill balanced diet containing little or no vitamin A bearing food. He states "In my experience these food materials"—raw milk, butter, cod liver oil, carrots and fresh green vegetables—"when suitably combined have protected my animals from these diseases and I do not doubt that in the hands of the surgeon they will go far to protect his human patients from them and facilitate their cure and non-recurrence after operation." McCarrison further calls attention to two points of interest to the surgeon: (1) If rats, fed on a diet low in vitamin A be infected with paratyphoid bacilli they usually die from the infection. In those that recover, the infection persists in the lymph glands for a long time after the general infection has been overcome. He infers that enlarged lymph glands in the human may be the result of persistence of infection as the result of a vitamin A deficiency diet. (2) There are breaches in the walls of defense against bacterial invasion consequent to the use of vitamin A deficient diets also that other vitamins may exercise an anti-infective action. He cites the observations of Arnold:

"The pathological examination of the dead animals following avitaminosis experiments shows evidence of tissue changes due to infections of various kinds. We have found that one of the first demonstrable changes in avitaminosis is an alteration in the dis-

tribution of the bacterial life within the lumen of the intestinal tract. The bacteria ingested by the mouth are not destroyed in the usual manner, but remain viable for many hours within the contents of the whole length of the small intestines. The mixed bacterial flora of the large intestines ascends into the upper levels of the small intestines. There is a gradual and progressive loss of the power of the body surface to control the microbic life existing in contact with it. These findings have been constant and hold for vitamins A, B, and D deficiencies. By the time the adult animal shows a loss of body weight or the young animals show a stationary weight curve, there is evidence of bacterial invasion of the mucosa of certain surfaces. These latter observations have been made by numerous investigators. We attribute the early inflammatory changes in the lining membranes of the eye, mouth, throat, alimentary tract, etc., to the loss of power of these body surface coverings to regulate the bacterial flora in contact with their cells. This precedes evidence of invasion of the membrane by bacteria."

More recent observations seem to indicate that vitamin A deficiency causes a change in the character of the epithelium lining the respiratory, alimentary, and genito-urinary tracts, also the eye. "The normal epithelium undergoes metaplasia or is replaced by stratified keratinizing epithelium" (Wiggers). This change is, no doubt, due to the lack of vitamin A. Wiggers believes that this accounts for the eye changes, the formation of renal calculi, and that the altered epithelium of the respiratory and alimentary tracts has lost its power to resist bacterial invasion, thus accounting for respiratory infections and gastro-intestinal disturbances. Be the mechanism what it may, all experimental evidence points to the fact that in vitamin deficiency, especially vitamin A deficiency, there is a decided tendency toward a breakdown of the resistance to infection involving especially the respiratory and gastro-intestinal tracts. This fact should be of more than passing interest to the surgeon in view of the frequent post-operative respiratory infections and gastro-intestinal disorders.

There are several significant facts concerning vitamin B deficiency. It is known that anorexia is a prominent symptom of vitamin B deficiency, in fact, this is so striking that many observers have concluded that all of the typical symptoms of vitamin B deficiency can be accounted for on the basis of malnutri-

tion incident to incomplete starvation. The polyneuritis due to vitamin B deficiency may be a confusing factor in dealing with certain types of neuritis and arthritis encountered in the human.

Vitamin D deficiency is associated with calcium metabolism. Sherman states that probably about one tenth of the American families not consciously underfed were nevertheless subsisting on dietaries deficient in calcium and were therefore undernourished in this respect. It has been shown that there is a daily exchange of 0.88 gram of phosphorus and 0.45 gram of calcium in the adult of average weight; therefore it is necessary that the diet contain at least that amount of each in order to maintain a normal chemical balance as pertains to these minerals. Recent investigators stress the importance of ample calcium and phosphorus intake especially in the individual who is suffering from bone disease or parathyroid dyscrasia.

In summary in regard to mild states of malnutrition it is well expressed by Minot:

The borderline states of nutritional insufficiency need better recognition as does the fact that apparently satisfactory nutrition does not mean optimal nutrition. Chronic departure from the optimal diet even if slight can produce ill health when operative over a long period of time and especially if combined with digestive disorders or other adverse factors.

When considering the grossly inadequate diet McCarrison states:

I claim for this experiment that it proves conclusively that one-sided diets which are disproportionately rich in cereals and poor in animal fats, milk, and fresh vegetables are capable of inducing in albino rats a large proportion of the disease included in our calendar of human ailments. I may add that of all faulty diets I have used that composed of white bread, margarine, tea, sugar, jam, preserved meat, and scanty overcooked vegetables—a diet in common use by many people in this country—proved to be one of the worst and most likely to be associated in rats with many of the morbid states I have mentioned, especially diseases of the respiratory and gastro-intestinal tracts.

The common and characteristic manifestation of malnutrition or starvation is loss of weight and strength and it has been demonstrated both upon the experimental animal and the human that states produced by rather

prolonged periods of starvation can be corrected by an adequate diet provided the period of starvation has not been too long. Moreover the manifestations of starvation are less pronounced and are delayed if water balance is maintained.

In the pathological patient who is a candidate for some surgical procedure added factors become operative. Among these are inadequate water intake and often excessive loss of water fever which calls for an increase of energy-producing elements, toxemia which affects essential parenchymatous organs especially the liver, heart, kidneys, and the ductless glands; impairment of the hematopoietic tissues leading to anemia; interference with digestion and absorption especially in those cases in which the gastro-intestinal tract is the seat of disease and no doubt other under-termined factors. These additional elements remove the individual from the category of simple malnutrition or starvation and place upon him burdens which may contribute to serious complications.

The mechanism or organs responsible for making fixed body tissues available for necessary energy are not known. It is entirely possible that due to changes in certain organs the mechanism may be interfered with sufficiently to deprive the individual of absolutely necessary energy-producing material and thus precipitate a fatal issue. Many side issues are involved in this complicated process of nutrition during a state of malnutrition and starvation in the pathological patient. It is believed that certain amino acids are necessary in the production of hormones as an example, tyrosine in the formation of thyroxine and cystine for insulin; therefore, in case of a protein deficiency an insufficient amount of the essential amino acids may contribute to a general hormone deficiency as exemplified by the great weakness and exhaustion with low blood pressure and subnormal temperature indicative of thyroid and adrenal insufficiency. It has also been shown that a low protein diet leads to a decrease in gastro-intestinal secretion and motility in fact with absence of protein intake gastric motility can be completely inhibited.

The pathological process itself may seriously interfere with nutrition. Reference may be made to an obstruction at the ampulla of Vater leading to biliary and pancreatic stasis. The absence of pancreatic enzymes in the intestine prevents digestion of the limited amounts of food ingested. With stasis, changes take place in the liver which may prevent glycogen storage even if sugar be made available in the form of intravenously administered glucose. Moreover changes in the pancreas may further contribute to the general breakdown.

When the pathological, starved patient is submitted to a surgical procedure, immediately there are introduced more factors. The loss of water by perspiration, loss of blood incident to the operation, trauma in variable amounts to sundry tissues or organs, varying degrees of shock which further depresses vital functions and lowers the already low blood pressure, the spread of existing localized infection and the liberation of tissue juices or toxic substances due to lysis of tissue cells incident to hemorrhage and trauma. During this postoperative period, the patient is totally deprived of all food with the possible exception, at times, of glucose which may be administered intravenously, and the water intake may be inadequate. It requires little imagination to visualize possibilities. So frequently we hear the expression, "The patient was too weak and could not withstand the operation." How true the statement and how little was done to prevent the catastrophe. Every surgeon has observed a state of utter exhaustion, lethargy, at times disorientation, nausea with vomiting, abdominal distress, a sallow skin and dry tongue shortly after operation, there being no evident explanation for the condition. The attendant nurse expresses recognition of the condition so frequently and so aptly by "The patient looks sick." I am convinced that in many instances it is the result of starvation in the individual upon whom another burden has been placed. At the time of this writing such an observation was made by me.

A man of 70 had a carcinoma of the sigmoid and a complete obstruction of a number of days' duration. The only assistance he had received from his attend-

ing physician was the introduction of a liberal amount of barium by mouth, 11 days previously, the barium being well distributed but retained in the colon. Several days after a colostomy the patient was found lethargic, mumbling, his skin dry in spite of the administration of liberal amounts of salt and glucose solutions intravenously and subcutaneously, the blood pressure was low, he complained of anorexia, nausea, and great exhaustion. His skin appeared sallow and there was evidence that he was in a critical condition. He was given, after much urging, two eggs, milk, and diluted orange juice. Within 12 hours his condition was radically changed. His skin was pink, he conversed without effort and handled himself easily in bed.

Such observations, I am convinced, can be made frequently.

#### CLASSIFICATION

The underlying factors which contribute to causes of malnutrition or subtotal starvation are varied and in many instances are overlooked by the physician. I should like to present a classification to cover the majority of instances.

1 *The economic status* Many individuals try to subsist, because of the expense, upon inadequate diets which are seriously lacking in animal fats and proteins and high in carbohydrates. So frequently the following dietary history is obtained. For breakfast some toast and a cup of coffee, a typical "soda counter" luncheon consisting of sweet rolls, perhaps a lettuce sandwich, and another cup of coffee, for dinner some overcooked vegetables, perhaps a little meat also overcooked, a salad, a sweet dessert, and coffee or tea. This is the diet which produced the characteristic changes in the rat described by McCarrison, and which he firmly condemns. Because of the cost, the vegetables used are the low food value type, such as carrots, cabbage, and the like, and also because of the cost, cereals are used in excess and the meats consumed are low both in quality and quantity.

2 *The voluntary diet* Since the slender figure is so much desired, many women deliberately starve themselves in order to attain and maintain it. Their diets are wholly inadequate and when investigated reveal some startling facts. For instance a cup of black coffee for breakfast, lettuce salad or sandwich and tea for luncheon, a salad consisting of

lettuce cucumber radishes possibly a small quantity of lean meat and more coffee for dinner. The wonder is that more instances of a serious nature do not manifest themselves.

In cases of obesity which are not under adequate medical control equally illogical diets are often indulged in. There is a great reduction of the intake of food including proteins as well as carbohydrates with the result that protein deficiency manifests itself. These patients lose weight but complain of great weakness and inability to carry on their usual activity. They may develop an edema and albumin is commonly found in the urine. Such unfortunately is the status of some patients with gall bladder disease who have dieted themselves upon the instructions of the physician to lose weight before operation. The patient with an albuminuria frequently has the protein intake markedly restricted as a preparation for a surgical operation and presents himself in a state of extensive protein deficiency.

The dyspeptic individual and the one suffering from some allergic disease frequently subject themselves to elimination diets. By constantly eliminating food elements in an effort to find that specific one or group that may be producing the unfavorable reaction the diet has become so restricted that forms of malnutrition and avitaminosis develop and are not recognized being often masked by a screen of some obscure organic disease. In the dyspeptic patient it is important to recognize this condition because of the frequency of the need for surgical interference.

*3 Loss of appetite due to chronic diseases*  
Those individuals suffering from some form of chronic infection often have no desire for food; moreover their appetites are perverted in that they crave those foods which are entirely insufficient. Their protein intake is inadequate and they utterly refuse those essentials of the dietary which their condition demands. They refuse eggs, milk, butter and fresh vegetables. Orange juice upsets their stomach. Their diet is essentially a carbohydrate one. The less they take the more they voluntarily restrict their diets and I am convinced that much of the loss of weight

weakness and the inability to combat infection is due to malnutrition and unrecognized states of avitaminosis. Mental states play an important role in loss of appetite. Worry over the nature or outcome of their illness and concern of economic or family affairs are to be considered.

Loss of appetite is a common symptom in malignancies and may appear early in the course of the disease. I believe that in a considerable number of cases starvation is as great a factor in the loss of weight and strength early in the process as the presence of the malignant disease. With obstruction such as may obtain in carcinoma of the esophagus, cardia or pylorus the nutritional status becomes a factor of paramount importance. It has been my experience that those patients who can be adequately nourished have less distressing symptoms, lose less weight and strength and live considerably longer.

*4 Conditions associated with pernicious vomiting*  
This group needs little amplification. However it should be brought to our attention that some individuals may eat what appears to be an adequate intake yet because of its nature the food value is insufficient in quality as well as in quantity and a false sense of security may be established. It may also be said that due to persistent vomiting there is not only an insufficient intake but a real loss of essential substances which further contributes to the patient's decline.

*5 Peptic ulcer*  
Due to the prolonged restriction in diet during the average medical management of peptic ulcer deficiency states are prone to develop. Davidson cites 3 cases with digestive disorders which during the course of ulcer diets manifested deficiency symptoms as evidenced by dental caries, bleeding, spongy gums, purpura and intra-muscular hematomas. He states:

In such conditions as peptic ulcer in which the etiology is obscure and every effort must be made to improve the general metabolism it is likely that a superimposed deficiency disease would be extremely detrimental. Indeed peptic ulcer itself may possibly be looked on as an example of tissue destruction like scurvy secondary to vitamin deficiency.

Even though some may not agree with Davidson that peptic ulcer is a deficiency disease, we cannot but agree with him that starvation and states of avitaminosis are not conducive to recovery from peptic ulcer. In those instances of peptic ulcer associated with persistent vomiting, the state of malnutrition will make itself manifest in a relatively short period of time and becomes a vital factor in the recovery of the patient. It is of this group of cases and their management that I will speak later.

*6 Metabolic diseases* Under any condition in which the metabolic rate is increased, more energy producing foods must be made available. This is clearly demonstrated in hyperthyroidism. Unless the diet of the toxic thyroid patient is adequate, there will be a marked loss in weight and strength. Here, again, it must be stated that carbohydrates are essential but proteins must not be excluded as an adequate protein intake is necessary. There is an old adage, "Starve a fever and feed a cold." It is interesting to note that even today some medical men still cling to this axiom, this despite the marked revolution which began about 1906 when typhoid fever patients were first fed liberal diets. It is the consensus today that fever cases demand sufficient food to sustain them and not to allow the body tissues to be metabolized.

*7 Conditions in which there is an inability to utilize ingested foods* This condition has been alluded to earlier in this paper in citing the incidence of obstruction of the pancreatic and common bile ducts so that the digestive enzymes are prevented from entering the intestinal tract. Under such conditions, there may be an ample intake of food, but because of the absence of digestion the patient will derive little benefit, there will be a rapid loss in weight and strength and a typical clinical picture of starvation will ensue. Mackie and Henriques studied 75 consecutive cases of ulcerative colitis from a nutritional standpoint and report deficiency states as manifested in changes in the mucous membranes of the tongue in 46 cases, abnormal buccal mucosa in 4, abnormal skin conditions in 11, anemia in 39, peripheral neuritis in 1, blood chemistry changes in 7, and 3 with inversion

of the albumin-globulin ratio and extensive edema. No doubt those cases of achlorhydria associated with diarrhea will sooner or later develop deficiency states.

*8 Mental disease* Many of the psychoses are associated with varying states of malnutrition due to the marked curtailment of the food intake. In dementia præcox states of advanced starvation are frequently found because the individual either will not eat or vomits ingested foods.

*9 Alcoholics and drug addicts* often present forms of malnutrition which should be recognized.

This subject of malnutrition and avitaminosis is of major importance to the surgeon, first, because of the possibility of errors in diagnosis and, second, because of the influence it has upon the outcome of the surgical procedure.

I have alluded to the clinical manifestations of protein starvation. Such states, I am convinced, may lead to a fatal termination if not recognized and corrected. Gastrointestinal symptoms, such as excessive vomiting, loss of appetite, nausea, abdominal distress, variations in gastro-intestinal tonus, diarrhea and the like in many cases are symptoms of malnutrition or avitaminosis. Infection of the respiratory tract, one of the grave postoperative complications, in quite a few instances, has its origin in faulty nutrition. There seems little question but that wound infection, trophic ulcers, such as bed sores, secondary urinary infections and forms of stomatitis, in many instances, may be accounted for on the basis of malnutrition. Vascular changes have been observed in cases of faulty nutrition to the degree that postoperative pulmonary embolism may suspiciously be concerned. The ability of the body to repair may be impaired during malnutrition. It has been my experience that in practically every case of evisceration that I have encountered, the patient was undernourished, moreover, of those cases in which wound repair has been delayed and wound infection present, many were in a state of malnutrition.

By correlating the results of observations made upon experimental animals and proved

cases of malnutrition and avitaminosis and many postoperative complications I am convinced that there will be revealed a similarity worthy of notice

#### DIETARY REGIMEN

I shall not attempt to describe the dietary regimen of the surgical patient. The duty of the surgeon is to recognize and evaluate the state of faulty nutrition if present so that it may be corrected. However a number of specific conditions make it necessary that the surgeon institute special means to nourish the patient. Among these may be mentioned (1) extensive ulcerations of the stomach (2) carcinoma of the stomach (3) carcinoma of the esophagus (4) duodenal or gastric ulcer with acute exacerbation associated with excessive vomiting and marked nutritional disturbances (5) gastrojejunal ulcer (6) post gastro enterostomy persistent vomiting (7) after gastric resection in the undernourished individual (8) linitis plastica (9) extensive trauma to the stomach (10) extragastric or duodenal lesions associated with marked nutritional disturbance in the presence of excessive vomiting. In these cases the ability to nourish the patient becomes a vital factor and the outcome will depend upon whether sufficient food can be administered so that life may be maintained. In such cases jejunostomy with jejunal alimentation becomes the procedure of choice.

Many attempts have been made to nourish the devalitized patient by means of jejunostomy and jejunal alimentation but in many instances the procedures have resulted in failure because the food used irritated the intestinal tract or was unsuitable from a nutritional viewpoint. It was not until Ivy and his co-workers after extensive experimental work upon the dog developed a pabulum which would not irritate the intestinal mucosa that successful jejunal alimentation became possible. They also suggested that the pabulum be administered slowly simulating the manner of emptying of the stomach. The Ivy pabulum consists of whole milk 1 500 cubic centimeters cream (20 per cent butter fat) 500 cubic centimeters cane sugar 150 grams wheat flour 1 0

grams peptone (dried) 80 grams water 2 000 cubic centimeters. From 6 to 12 grams of salt depending upon the need is added. This amount represents about 3 340 calories and is intended for a one day feeding. The specific amounts of sugar peptone flour and cream will have to be varied depending upon the individual tolerance to carbohydrates proteins and fats. In addition to this feeding there is added daily a vitamin feeding consisting of orange juice 100 cubic centimeters 1 egg yolksterol 3 drops haliver oil 5 drops and 1 tablet of Harris yeast. It has been shown that with such feedings correctly administered the experimental animal will maintain a proper nutritional state for many months. Scott and Ivy have also demonstrated upon the dog with a Pavlov pouch that adequate jejunal feeding reduces an excessive acid gastric secretion and with the addition of atropine the acid secretion may be entirely eliminated also that with continuous feeding hunger contractions are inhibited thus putting the stomach at rest.

#### JEJUNOSTOMY

A left upper transrectus incision is used when the operation is done primarily for a jejunostomy. A burned exploration may be done and a loop of the jejunum approximately 12 inches from the duodenojejunal junction is brought into the wound. A catheter is implanted by the Witzel method at the anti-mesenteric side of the gut the catheter being inserted at least 8 inches into the lumen of the jejunum. We have used ordinary soft rubber catheters ranging in size from 0 to 24 (French). It is important that the catheter extend well down into the lumen of the gut so that the pabulum is introduced into the gut away from the site of opening thus reducing the possibility of leakage. The catheter is fixed to the wall of the jejunum by two catgut sutures at the site of the jejunal opening and is then drawn through an opening in the omentum and brought out of the abdomen through the lower end of the abdominal incision. The jejunum is fixed to the abdominal wall with a catgut suture to prevent separation in the event the catheter is pulled out of place. The remaining portion



of the abdominal incision is then snugly closed. In the event that the jejunostomy is done as a complementary procedure when a right rectus incision has been employed, the catheter is drawn through a stab wound through the left rectus muscle at a site convenient to the position of the loop of gut employed. If care is taken the catheter will remain in place for a number of days. However, if it is accidentally expelled or pulled out of place, it can be introduced again quite easily. After cleansing, the catheter should be well lubricated with such an agent as KY jelly and gently inserted. No force should be used for as soon as it enters the gut the peristalsis will draw it along.

#### JEJUNAL FEEDING

The usual errors in jejunal feeding are the use of an irritating food and incorrect administration. The specific tolerance of each individual must be determined during the early stages of the feeding. In the majority of instances the pabulum is given too rapidly. After considerable experimentation there was built, by the Department of Physiology of Northwestern University, an electrically driven pump which will deliver any quantity of pabulum desired during a specific period of time. By a regulation of the speed and length of the piston stroke the pabulum may be given, drop by drop, or as much as 300 cubic centimeters can be given in 15 or 20 minutes. This apparatus seems to have solved the problem of the administration of the pabulum.

It is our custom to begin the administration of water almost immediately after the jejunostomy. The pump need not be used for this since the drop method will answer the purpose very well. Care should be exercised in the early administration of water since if it is given too rapidly nausea or distention will develop. This we believe is due to decreased intestinal motility incident to the operative procedure or the anesthesia. The pabulum feedings are begun from 18 to 24 hours after the jejunostomy, the pabulum being diluted 50 per cent by water. Fifty cubic centimeters of the diluted pabulum are given over a period of from 15 to 20 minutes every hour.

If any symptoms develop, the feedings are given every 2 hours. As tolerance is acquired the amount of the feeding is increased so that when 100 to 150 cubic centimeters can be given during a period of 20 minutes every hour, the pabulum is no longer diluted but the amount is decreased again so as to allow the gut to accommodate itself to the nature of the pabulum. Gradually the amount of the feeding is increased until a sufficient quantity is administered to supply nutritional requirements adequately. From 3000 to 3500 calories can easily be administered without discomfort to the patient. (The vitamin feeding is not begun until the patient is able to tolerate full feedings of the standard pabulum. This usually requires from 3 to 4 days.) It has been noted that occasionally the patient will develop diarrhea or cramps. Nausea is not infrequent. The nausea is due in most instances to too rapid feeding. Cramps and diarrhea are due to the patient's inability to handle the fats or orange juice in the feedings. Occasionally, the sugar content is too high, therefore it is essential carefully to observe the individual's response to the feeding used and to modify it to avoid discomfort.

In some instances it becomes desirable to add to the pabulum other substances or drugs as may be indicated. In the presence of a pyloric obstruction with excessive vomiting or when large amounts of fluid are aspirated from the stomach, the addition daily of from 250 to 1000 cubic centimeters of the aspirated fluid to the pabulum, in divided amounts, is productive of beneficial results. We have added chondroitin in cases of liver damage, pancreatin in pancreatic disease with evidence of improper digestion of the pabulum, opium when excessive diarrhea and cramps were present, bile salts with common duct obstruction, and codeine and allied drugs for pain of any origin.

It has been a striking observation to note the improvement in the state of nutrition of the patient in a short period of time. The relief of pain due either to ulcer or carcinoma of the stomach will be prompt. The average case of carcinoma of the stomach will be completely relieved of pain within 48 hours and in ulcer cases as early as 24 hours.

The duration of the jejunal feeding regimen will depend upon the condition for which it is used. The longest time we have employed continuous jejunal feeding was in a case of extensive ulceration of the stomach in which jejunal feeding was continued for approximately 9 months.

### CONCLUSIONS

I should like to make a plea to the surgeon as well as to the medical practitioner to scrutinize more closely the nutritional status of the surgical patient. The accustomed dietary of the patient should be studied in order to anticipate dietary deficiencies as well as to recognize them when present. Every patient who is to be operated upon should have a well regulated diet for some days prior to the operation if the nature of the condition will permit. During convalescence the nutritional status of the patient should be as closely observed as the surgical wound or the specific condition for which the patient was operated upon. Postoperative symptoms and complications with the nutri-

tional status of the patient in mind should be analyzed especially with reference to vitamin deficiencies and protein starvation. Artificial feeding at times becomes imperative. This can best be accomplished by jejunostomy and jejunal feeding.

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# CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF OREGON

## THE RÔLE OF THORACOSCOPY IN THE DIAGNOSIS AND MANAGEMENT OF LUNG TUMORS<sup>1</sup>

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THE purpose of this contribution is to call attention to the value of thoracoscopy in the diagnosis of intrathoracic new-growths. No reference will be made to its use in intrapleural pneumolysis by the closed method, as I have previously detailed that subject.<sup>2</sup>

Thoracoscopy is undoubtedly one of the most neglected diagnostic procedures in clinical medicine. The value of bronchoscopy, cystoscopy, and ophthalmoscopy has been recognized for years, and in every worthy textbook on diagnosis will be found a discussion of their diagnostic import and interpretation of the various images disclosed. In short, the rôle of the above procedures, in their respective fields, is well known to every medical student. Thus, it seems incredible that so important a region as the pleural cavity should be excluded from study with an optical instrument similar to the cystoscope—if the paucity of contributions on the subject is any criterion. The subject has received little attention except for the value of thoracoscopy in the identification and localization of adhesions preventing a satisfactory pneumothorax in the treatment of pulmonary tuberculosis, and as a guide to their severance.

In the differential diagnosis of intrathoracic neoplasms, thoracoscopy will give information otherwise unobtainable. Moreover, in contemplated operative procedures, one may determine by this method the nature of the growth, its distribution, and the possibility of its surgical removal.

The technique of thoracoscopy consists in establishing a diagnostic pneumothorax of sufficient capacity to permit visualization of the pleural cavity, especially of the tumor mass. The uninjured lung tissue, if there is a tumor of the lung, should be well collapsed. This can be accom-

plished in two or three pneumothorax treatments at 2 to 3 day intervals, controlled by the fluoroscope. After a suitable pneumothorax has been established, a set of stereoscopic films is studied to determine the location of the mass and the most appropriate site for introducing the thoracoscope.

The Unverricht thoracoscope permits the most adequate visualization, it is introduced under local anesthesia infiltration (1 per cent novocain suprarenin solution) of the particularized intercostal space. A 1 centimeter skin incision is made with the tenotomy knife, and the Unverricht valve cannula<sup>3</sup> and trocar are inserted into the pleural cavity. Introduction of the thoracoscope follows upon removal of the trocar, the surgical amphitheater is darkened and a complete study is made of the pneumothorax cavity. Having located the growth, a second puncture at a suitable site is made identical to the first and through this a biopsy forceps introduced through a small cannula for the purpose of securing a specimen for histopathological examination. In the interim, depending upon the contemplated operative procedure, the pneumothorax is either maintained or abandoned.

Concerning the removal of specimens for biopsy, it should be mentioned that the Unverricht biopsy forceps have proved of little value because of the difficulty of getting a "bite" of tissue, as the

<sup>3</sup> The author prefers the valve cannula of Unverricht for the sole purpose of thoracoscopic diagnosis, whereas for all pneumolysis procedures, the author's bakelite cannula is preferable.

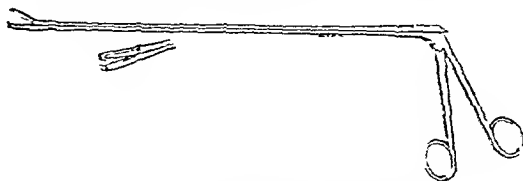


Fig. 1. Author's biopsy forceps.

<sup>2</sup> Am. Rev. Tuberc. 19 9 19 33 Arch. Surg. 19 9 19 1173 Graham Sinker and Ballou Surgical Diseases of the Chest Philadelphia Lea & Febiger, 1915 Cyclopaedia of Medicine Philadelphia F. A. Davis & Co. 1935 and Goldberg, Benjamin Clinical Tuberculosis Philadelphia F. A. Davis & Co. 1935

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Fig 2. Roentgenogram showing circumscribed area of increased density in the periphery of the left lung field which is interpreted as probable chest wall tumor (Reproduced through courtesy of W. B. Saunders Co.)



Fig 3. Roentgenogram of the chest after thoracotomy showing lung attached to the tumor (Reproduced through courtesy of W. B. Saunders Co.)

lung is too often forced away from the grasp of the forceps when an effort is made to close its jaws. Moreover if the pleura is thickened one seldom gets a section deeper than the pleura besides the pathologists always complain that the specimen is too diminutive to allow intimate study. Other forceps have been tried such as those used in securing specimens by bronchoscopy and those of the punch type—none of which have been found suitable.

In order to secure a satisfactory biopsy specimen an especially designed forceps was devised for this purpose. These forceps are provided with jaws giving a substantial cutting surface whereby a sufficient section of tissue can be bitten off. The jaws of the forceps are faced with a flexible rim having fine teeth. In securing a specimen the fine teeth fix the lung as the cutting surfaces remove the specimen (Fig. 1).

While thoracoscopy is of great value in establishing a diagnosis of lung tumors it is of particular significance in the differentiation of those primarily of the pleura with metastasis to the lung or vice versa. This simple method enables one to determine if the tumor is primarily one of the pleura with secondary extension to the lung—also the character and extent of the invasion can be seen and the probability of successful removal

decided upon. If the lung is sufficiently collapsed complete visualization and study of the pleural cavity can be made provided very broad or extensive adhesions do not obscure certain areas. In any event a definite diagnosis of the tumor type can be made before operation either by the thoracoscopic images grossly visualized or by the study of the biopsy specimen. In this way one becomes perfectly orientated regarding its size, position, extent of invasion, vascularity, and relationship to important structures. Valuable disclosures such as recognizing the best surgical approach and adjudging difficulties to be encountered are obtainable by no other method—consequently the usefulness of thoracoscopy can be readily appreciated. If the tumor is adherent to the chest wall by band adhesions or other adhesions of an operable type they can be severed electrosurgically at the time of thoracoscopy—thus simplifying the subsequent surgical removal of the tumor.

The rôle of thoracoscopy in the diagnosis and management of intrathoracic new growths perhaps may be best indicated by the following cases:

CASE. Mrs. M. H. T. aged 73 years presented herself at the Outpatient Clinic of the Medical Department of the University of Chicago, October 7, 1937. Her chief com-

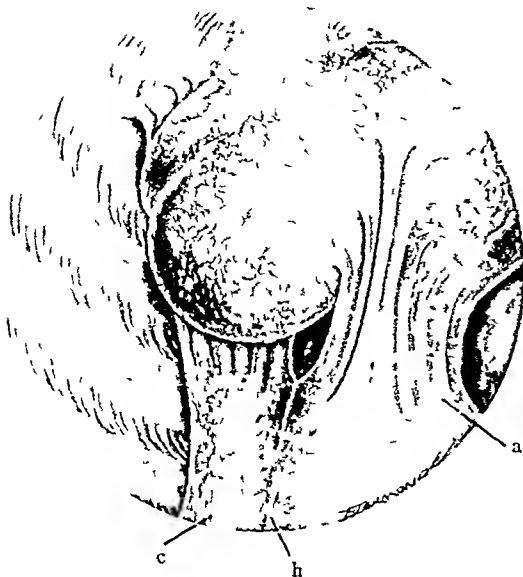


Fig 4 Thoracoscopic view of intrathoracic portions of a primary osteogenic sarcoma of the rib a, Band adhesion holding upper lobe of the lung to tumor b, Interlobar fissure c, Highly vascular lower lobe of the lung directly adherent to mass (Reproduced through courtesy of W B Saunders Co)

plaint was pain in the left shoulder which radiated downward and forward beneath the left breast. Her family and personal history were irrelevant. The pain was of a dull, aching character, but at times was superimposed by severe attacks. Pain was first noticed early in December, 1931. Aside from pain and a progressive weakness and loss of weight (amounting to 15 pounds since the onset of her illness) she had no complaints.

The physical examination was reported essentially negative, aside from a small, painful nodule on the seventh rib posteriorly near the rib angle. The roentgenological examination revealed slight limitation of movement of the left diaphragm. The heart was normal in size, shape, and position. The right lung field presented no aberrations. In the periphery of the left lung field was a large mass, 7 by 8 centimeters, projecting intrathoracically from the chest wall, attached apparently to the seventh rib in the mid-scapular line, the rib revealing some enlargement at the point of location of the mass. The lung field was otherwise clear, and no enlargement of the hilus shadow was discernible. The mediastinum was normal. Roentgenological study of all bones revealed no abnormality. The roentgenological diagnosis was "probable tumor of the chest wall" (Fig 2).

Her blood pressure was 116/72, pulse rate 92. Blood examination revealed white blood count, 7350, polymorphonuclear neutrophils, 70 per cent, polymorphonuclear eosinophils, 1 per cent, polymorphonuclear basophils, 2 per cent, lymphocytes, 25 per cent. No pathologic cells were found. The red blood count was 3,790,000, hemoglobin 77 per cent. The Wassermann reaction proved to be negative. There was no sputum obtainable for examination. Examination of specimen of urine proved to be negative.

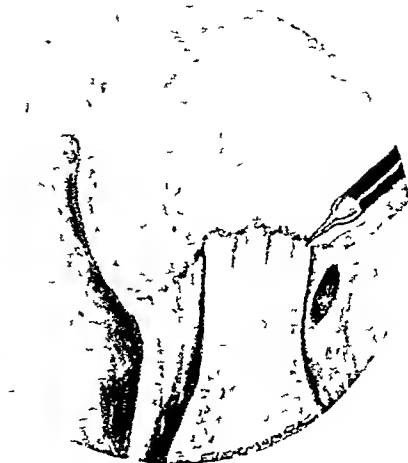


Fig 5 Thoracoscopic view showing electrocoagulation of the lung attachment to tumor as a preliminary to the removal of the mass (24 days later). This method was employed to lessen bleeding and danger of metastasis to the lung (Reproduced through courtesy of W B Saunders Co)

On October 15, 1932, a diagnostic pneumothorax was made for purposes of thoracoscopic study of the tumor and to obtain a specimen for biopsy. Roentgenological study, after the pneumothorax was fully established, revealed a mass the size of a very large orange attached to the seventh rib posteriorly, also, the lung was adherent to the mass (Fig 3). The mediastinum was mobile.

On October 17, 1932, after a refill of gas in the pneumothorax cavity, a thoracoscope was introduced through a chest wall puncture in the ninth intercostal space, posterior axillary line, under local anesthesia infiltration. The thoracoscopic examination revealed a highly vascular, globular mass, constricted in the middle, arising from the seventh rib, but adherent to the sixth and eighth ribs and intervening intercostal spaces with dense pleuritic adhesions. Both lobes of the lung were adherent to the tumor, the upper lobe being attached by a band adhesion, in which no invasion of the tumor could be observed. The lower lobe had a highly vascular attachment to the tumor and showed evidence of beginning invasion from the tumor mass to the lung (Fig 4). The mediastinum was seen to be mobile. The pleural cavity was otherwise normal. Several sections were taken for biopsy by means of biopsy forceps introduced through another chest wall puncture under local anesthesia.

The thoracoscopic diagnosis was osteogenic sarcoma. The biopsy report was malignant tumor, probably osteogenic sarcoma.

Because of the mobile mediastinum, and the danger of flutter during the open operation, we decided to stiffen the mediastinum by inciting a circumscribed pleuritis of the mediastinal pleura at the weak point of Nitch. This was accomplished by injecting 2 cubic centimeters of 2½ per cent oil of gonol in paraffin oil through the second intercostal space near the sternal border, the patient resting on the table with pneumothorax side up. After ½ hour the gonol solution was washed out with normal saline. Following this a slight serofibrinous exudate occurred, with subsequent fixation of the mediastinum.



This case is presented to illustrate the importance of thoracoscopy in diagnosing diseases of the lung and pleura, and particularly to call attention to its value in establishing a diagnosis of tumor of the chest wall, with intrathoracic extension, or of tumors of intrathoracic origin. The procedure is simple and harmless. In this case it was possible to make a definite diagnosis of the tumor type before operation, and to ascertain definitely its size, position, vascularity, and relationship to the lung. Had the lung been adherent to the tumor by band adhesions only, they could have been quite easily severed electrosurgically, under thoracoscopic guidance, thus simplifying the major operation. This being impossible, the tissue between the lung and tumor was thoroughly electrocoagulated, so obliterating large vascular channels and diminishing the formidability of the major operation to a marked extent. Thoracoscopic examination also revealed that the mediastinum was labile. Obviously, upon opening the chest wall the danger of flutter was imminent, but by the procedure outlined, rigidity of the mediastinum was established and at no time when the chest wall was open was there any evidence of mediastinal movement, hence, the patient was rendered a much better surgical risk. The pre-operative pneumothorax too presented a distinct advantage, because the danger of shock by the sudden collapse of the lung during the open operation was avoided. Furthermore, by this means, we determined beforehand that the lung was adherent to the tumor, and the operation was planned accordingly.

I feel certain that the preliminary procedures contributed materially to the simplicity of the major operation. Through correspondence with many thoracic surgeons, I have been informed that this is probably the first case of chest wall tumor where the diagnosis was made by thoracoscopy. The preliminary operative procedures are likewise unusual, but advantageous.

**CASE 2** L. R., age 60 years. Seen December 28, 1933, through the courtesy of Dr. Frank L. McCauley, internist in the Dr. Robert C. Coffey Clinic and Hospital. The patient was a farmer, male, family and past medical history of no importance. The chief complaint was shortness of breath, heaviness through the chest, bloody sputum at times, which began 3 months prior to admission on November 3, 1933. He complained of a burning sensation in the throat, perspired freely while working, had no night sweats, his appetite was poor. He had been losing weight steadily. His average weight was 195 pounds—present weight 184 pounds.

The physical examination revealed a large frame, of medium nutrition, coarse skin. Chest was large and of the emphysematous type. There was an impairment of percussion resonance over the upper half of the right hemi-



Fig. 8. Roentgenogram of Case 2, showing a suspected bronchogenic carcinoma of right lung.

thorax anteriorly and to the fourth dorsal spine posteriorly. Below this area, the percussion note was somewhat hyperresonant. Over the impaired area could be heard distant crackles with increased whispered fremitus with bronchovesicular breathing. The remaining portion of the right lung presented typical findings of a compensatory emphysema. Examination of the left lung field disclosed no abnormal findings. The heart was normal.

Roentgenological examination revealed a dense mass occupying the upper lobe of the right lung (Fig. 8).

The impression from physical and roentgenological examination and history of the case was "probable tumor of the right lung." Bronchoscopic examination was undertaken. The bronchoscope passed easily into the trachea to its bifurcation. No obstruction was encountered in the first or second bifurcation, although at the second bifurcation of the right bronchus it apparently lost its rotundity and had a split-like appearance. The bronchoscopic findings were otherwise negative. No abnormal tissue was seen to justify removal of a section for biopsy.

A diagnostic pneumothorax (Fig. 9) was established and a thoracoscope introduced in the midaxillary line after the apparently uninvolved lung tissue had been collapsed. The thoracoscopic examination revealed a mass involving the entire upper lobe of the lung, which presented the characteristic gross appearance of carcinoma (Fig. 10). One could also see enlarged tracheobronchial glands.

The thoracoscopic examination was made, first, for the purpose of confirming the diagnosis, and second, for determining the possibility of excision of the growth. That is to say, if the growth were found circumscribed to the upper lobe, or with extension into the lower lobe without extensive involvement of the tracheobronchial glands, a



Fig. 9. Diagram of the thorax in Case 3, showing the location of the tumor of the lung.

l b c t o m y f o r f i n d t o n e l o t e o e e n p n u m n e t m y f m e x t e n c o u l d h e b n e s d e d p d e d n i a s o f t h e t a c h e o b n h f l a d h d t k e n p l c e

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Fig. 10. The gross appearance of the tumor, showing the central mass of the tumor, the outer layer of the tumor, and the surrounding tissue.

f a d m T h t u m m s s l c t d b o t h s e a A s m a l l p r t o o f t h e t u m o r u m m e d a t l y d j a c e n t a n d b e t h i t e r l b a r f s r b e t c n t h e m u d d l a n d p p l b a s o o t c T h t m w a s h t h a p p e n e a d r u d a g l a t u s l a t c e c t n. T h m e d i a s t a u m s p h e d e t o t h l f t T h b f t u n g l a n d s h e d c a r c i n o m a t i n o n

T h e h t p e n d o g r s b n m a h t a. T h l f t p l u l e a t y c t a i n e d a l i g h t c e o f f d d T h l e f t l g o t s e d a c a o f h y p o t i c p u m a. A t m r m a s e e c

T h b d m a l d p e l i c o g r e s s e t a l l y n g t e

T h e k l l w a s t p e d H l l g y T h t m m s i n t h e g h t l n g a b o h o g s c r o m a w i t h c l l d d e g a t o n T u m r m s c n t h e m d a s t a n l g a n d e p e s e t h c h h a d t h s a m e h u t l o g a l p p a n c s t h e t m r o f t h l g A m p o t t p a t h i g a l b a g e s w e r e n i n t h t h r t i s s e s

f a d c d g ( ) A l e o c m a f i g h t p p e l h t h m e t t o s t o t h m d t l g l a n d ( ) f i b r o p l a t c p u m n a l f t (3) l d g h t p l u r a l d h e (4) h y p o t a t c p u m n a l f t (5) t h a c t m y d r a b t h e m i t h r x

In the foregoing case the exact diagnosis of the actual character of the tumor was somewhat dubious by other available procedures but the final diagnosis was made by thoracoscopy. Furthermore thoracoscopy verified that the tumor was of an inoperable type.

Cas 3 J K m a l g e d 50 y s l t r e d t h m e d c a l s e r v e W l t m a h l l p t a l J a n r y 31 1935 T h s m w a l a b o e w h i m p l a n e d f e k n s s a n d a b f 5 m t h d u r a t i o n. D i n g t h f i r s t m o t h s f i b





Fig 11 Roentgenogram of Case 3 before diagnostic pneumothorax



Fig 12 Roentgenogram of Case 3 after diagnostic pneumothorax

illness his cough was unproductive. However, during the 3 months prior to his death he raised increasingly larger quantities of sputum (between 45 and 150 cubic centimeters daily) which, during the last 2 months, was mixed with blood. His loss of weight amounted to 20 pounds during the previous 5 months. He complained of chest pain 1 month prior to exitus.

The patient presented a pale although not cachectic appearance. Upon admission, his temperature averaged 99.2 degrees during afternoons, but it gradually assumed the septic type, and during the last 2 months, his temperature ranged between 101 and 103 degrees. His respiration on admission was 20 and pulse 100, but these both increased as his weakness became more progressive. Blood pressure was 104/64. Bacteriological examination of the sputum revealed no tubercle bacilli on repeated examinations. The blood picture was as follows: hemoglobin, 63.9 per cent, red blood cells, 3,360,000, white blood cells, 13,300, polymorphonuclears, 72, eosinophils, 1, ST, 18, mononuclears, 1, staff cells, 8. Sedimentation rate, 46/110. Kolmer reaction, 4 plus positive, Kahn, negative, urine, negative.

Admitting physician made tentative diagnosis of either fibrocaceous tuberculosis or a bronchogenic carcinoma.

The roentgenological report, on admission, follows: There is a large consolidation involving chiefly the lower portion of the upper lobe of the right lung. However, the entire upper portion of the right lung is involved. The shadow extends from the hilus to the periphery. There is a marked thickening of the pleura over this area, with possible small, multiple cavities containing fluid. Bronchogenic malignancy cannot be ruled out.

A bronchoscopy was performed. The Jackson bronchoscope was passed into the right bronchus. The mucosa appeared to be much thickened and red. A biopsy section was taken, but the section was unsatisfactory and the report stated that there was doubtful appearance of car-

cinoma with evidence of only a chronic inflammatory process. The case came to my service at this time (Fig 11).

A diagnostic pneumothorax was established under local anesthesia, after which a thoracoscope was introduced in the eighth intercostal space at anterior axillary line on right side (Fig 12). The pleural space was easily visualized. There were many bands of adhesions noted. The apical portions of the lung were adherent to the chest wall, slightly posterior to the point entered by the thoracoscope. A white, glistening protuberance was observed on the visceral pleura, adjacent to the point where the lung was adherent to the chest wall (Fig 13). It presented the typical appearance of a carcinomatous nodule. A cannula was inserted at about the ninth intercostal space and slightly posterior to the posterior axillary line. A specimen of this nodule was removed by means of biopsy forceps, but while the thorascopic diagnosis was carcinoma, the pathologist reported that the section was insufficient to justify a diagnosis. Exitus occurred October 20, 1935. The following is an excerpt of the autopsy report by Professor Frank Menne, head of the Department of Pathology, University of Oregon Medical School.

"The anatomical diagnosis was massive diffuse necrotic bronchogenic carcinoma involving the right main bronchus and obstructing the lumen with resultant necrosis and suppuration. (Other anatomical findings not pertinent to the subject matter under discussion will not be given.) The right lung was bound down everywhere with fibrous adhesions formed of thick connective tissue. These tissues were swollen firmly and slightly injected. Many small pockets of creamy white material were visible on the anterior central portion of the right lung. When the right lung was removed, it was found that the parietal and visceral pleurae separated with some difficulty. Along the posterior lateral portion, many small, fibrinous adhesions were found, with a small amount of fluid. On section, the right bronchus was occluded at its origin from the bifurca-

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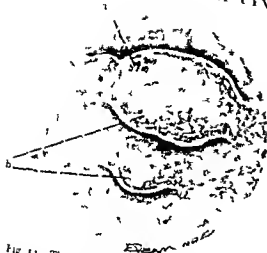


Fig 13. Thoracoscopic view of the nodular tumor on the lung parenchyma. The tumor is located in the upper lobe of the lung, and the surrounding lung tissue appears normal.

Because of the septic type of temperature and the rapid progression of disease and the general condition of the patient radical surgery was contraindicated at a time when even the thoracoscopic diagnosis established the presence of a bronchogenic carcinoma. I am certain that had this case been seen earlier it would have been ideal for total pneumonectomy.

While the number of cases that I have studied by this interesting method is small, those described are typical examples of the 14 remaining cases which have been extensively observed. And while the chief value of thoracoscopy as a means of diagnosis and guide to operative removal will concern tumors of the chest wall or intrathoracic organs as shown in Case 1, it will also provide an efficient and harmless medium for diagnosing tumors of the mediastinum and lung—provided in the latter case the mass has extended into the parietal pleura and is thus visible and appropriate for removal of a biopsy section.

In the case of mediastinal tumors, valuable information may be derived as pointed out regarding the nature of the mass as well as its relationship to important anatomical structures and the probable difficulties of its excision. In lung carcinoma when excision of the lobe or entire lung is contemplated, thoracoscopic examination will enlighten one previously of the extent of involvement and the possibility of successful operation rather than subjecting the patient to an exploratory thoracotomy to determine operability—a procedure which often proves hazardous in an older person. On the other hand, thoracoscopy will reveal all the information obtainable by a major thoracotomy and in comparison is neither involved nor injurious.

Since the method described is a new one, it is not surprising that it has not been widely known. The purpose of this paper is to bring it to the attention of the medical profession and to describe the technique of the procedure. The method is simple and can be performed by any surgeon who is familiar with the principles of thoracic surgery. It is a valuable addition to the armamentarium of the thoracic surgeon.

STEINBERG SURGICAL TREATMENT OF DEEP SEATED DUODENAL ULCERS 625  
THE SURGICAL TREATMENT OF DEEP SEATED NON-RESECTABLE  
ULCERS OF THE DUODENUM  
A NEW PLASTIC METHOD OF APPROACH

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THE surgical treatment of duodenal ulcerations by removal of three-fourths of the stomach is not based only on sound physiological principles, pathological realities, and anatomical relationships, but also upon the excellent results obtained. Where the indications for surgery are definite and the magnitude and nature of the procedure commensurate with the character of the lesion, there is no more gratifying operative procedure as far as results are concerned than a properly performed stomach resection.

Since I performed the first stomach resection for duodenal ulcer in 1923, my results have been so satisfactory that a natural skepticism connected with such a seemingly extensive procedure has changed to an enthusiasm and a confidence in the rationality of this form of surgery. The immediate and remote complications which not infrequently follow the indirect surgical procedures, though well executed and by the most competent men, are rarely met with in my experience after a subtotal stomach resection by one or the other of the rational modifications of the Billroth I or II methods. Complications inherent to a gastroenterostomy have forced a skeptical attitude in the ranks of the practitioners, internists, surgeons, and the laity. The excellent results obtained in many patients subjected to a gastrojejunostomy are marred by a definite percentage of poor results where the patient fares worse than he did before his operation. The morbid conditions and disappointments which frequently follow gastrojejunostomy depend largely upon the uncertainty of anatomical relations between the stomach and jejunum. Nor are the physiological changes expected under the same control as in a stomach resection. The history of gastro-enterostomy is replete with numerous modifications and methods in order to avoid its disasters and complications. Even the standardized posterior short loop gastroenterostomy is not without criticism as to its technical perfection as witnessed by contemporary writings (Moise).

The history of stomach resection has also witnessed an attempt of many to improve and modify its technical details so as to make the operation

safe and free from morbidity. It is only natural to expect that surgical procedures which change the anatomical and physiological relationships between the stomach and intestine cannot always be perfect. It will be pointed out elsewhere that the resection will give rise to an occasional jejunal ulcer or will result in dyspeptic symptoms in a few cases. The number of these is quite insignificant as compared with the original complaints and with the percentage of complete cures. The frequent argument against subtotal resection is the high mortality as compared with the various palliative procedures. This variable depends greatly on the training of the surgeon in this particular branch of surgery, and in the familiarity with the important physiological principles and anatomical relationships. Finsterer, Haberer, and several others report no greater mortality in the radical procedures than follow gastroenterostomy.

Several years ago it was my pleasure to visit a surgeon of international reputation who has adopted the subtotal stomach resection as a routine procedure and who frankly admitted that his mortality ranged from somewhere between 10 and 12 per cent. At that time I dared to advance the statement that the most frequent cause of his fatal results was pancreatitis. Upon refreshing his memory on the postmortem findings, the surgeon was forced to agree that that was the cause. Any surgeon who attempts to remove all of the deep seated duodenal lesions penetrating into the pancreas or adhering to the common duct, or to the duodenohepatic ligament, must expect a greater mortality. It is for such deep seated ulcers that Finsterer has wisely advocated the exclusion operation combined with an extensive resection. Floercken has treated such ulcers by closing the duodenum through the ulcer area, immediately above the ulcer, or through the pyloric ring, combined with a Billroth II, with excellent results. It is hardly necessary to point out that an attempt to close the duodenum through a fragile and inflamed wall or an ulcerated area is to court disaster.

The typical exclusion operation of Finsterer has been carried out in many patients with success.

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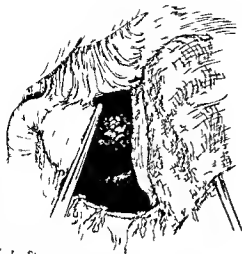


Fig 1 St mach h be a divided and the pr xun l  
p t reflect d t t l ft

as reported by Finsterer Denk Steinberg and others. Nevertheless there are certain theoretical and some practical objections to this procedure. Steinberg has definitely shown that the Devine exclusion transection without a resection produces jejunal ulcerations in a large percentage of the experimental animals. Recently Graham has reported 6 patients operated upon according to Devine all of whom developed ulcerations soon after the original procedure. It is comforting to know that this experimental work has been not

only of theoretical curiosity but of great practical importance. The clinical experience giving a hundred per cent jejunal ulcerations after the Devine procedure is highly supportive of the theoretical speculations. One familiar with surgery of peptic ulcers knows that the difference between the von Eiselsberg exclusion operation and the Devine procedure is only a trifle more than in the name. The Devine transection operation divides the stomach a little higher toward the cardia and terminates with a Pólya. Both produce their share of jejunal ulcers. The Finsterer exclusion operation differs greatly from the von Eiselsberg and Devine procedures in the important fact that three fourths of the stomach is removed. Haberer who maintains that no part of the pyloric end of the stomach however small should be left since it stimulates reflexly the secretion of acid from the fundus should be won over to the Finsterer exclusion operation by considering the removal of the mucosa from the stump of the pylorus left behind. Another more valid objection brought forth against the exclusion operation is an occasional perforation or fatal hemorrhage which took place in a few cases where the ulcer was left. There is also an occasional anxiety of insecure closure of the pyloric stump left behind. Difficulties may arise where the muscle is greatly hypertrophied or where the pyloric ring engaging the duodenal ulcer in the scar forms a narrow apex on which the base of the closed pyloric stump rests. Leakage from such a stump when it is closed under tension has been reported. Some advise that more of the distal pyloric antrum be

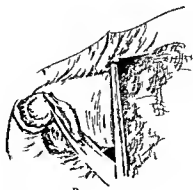
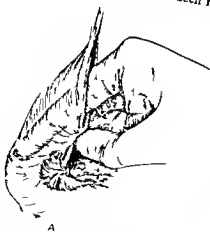


Fig 2 A P p t i n f t h duodenum th gh t  
B K m a l f t h e n t e r p a r t f t h duod n m  
wall of the duodenum is seen pen t atug nt th h  
pe d f t h e p y l r i n s t  
v l e u l c e r n t h e p o t  
d o f t h e p a c r e a s

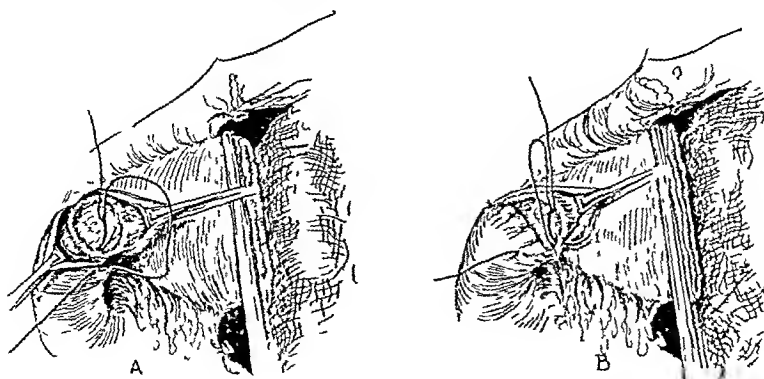


Fig 3 A, Approximation of the anterior wall of the duodenum to the distal edge of the ulcer B, Approximation of the anterior wall of the duodenum to the proximal edge of the ulcer

left—a procedure which has its objections, others recommend the extraperitonization of the pyloric stump. The important objection above all is offered mainly by the acutely bleeding ulcer on the posterior wall penetrating into the pancreas. An exclusion operation offers no direct attack on the bleeding ulcer. Nissen, Bsteh, and others advocate plastic procedures which utilize the mobilized anterior wall of the duodenum to cover the ulcer on the posterior wall.

Before going into details of the technical procedures of a plastic method which has been used by myself in several cases, it is of the utmost importance to make an orientation of the criteria which point to the choice of the procedure to be carried out with safety.

According to DoRio Brancho, Yule, and recently, Plenk, the blood supply of the duodenum consists of two vascular arches, which are found

on the ventral and dorsal sides of the head of the pancreas at a distance of from 1 to 3 centimeters from the duodenum. This arch is formed from the gastroduodenal and superior mesenteric and supplies both the duodenum and the pancreas. The part of the duodenum from the pyloric ring distal to where it is crossed by the gastroduodenal artery receives its blood supply from the branches of the right gastric and also the gastro-epiploic arteries. Plenk found areas of necrosis in the head of the pancreas from ligation of either the gastroduodenal or the right gastro-epiploic arteries. The dissection of the duodenum, beginning with the pylorus, should for these reasons stop at the level of the gastroduodenal artery, and furthermore, care should be exercised neither to ligate nor injure in any manner the gastroduodenal artery or the gastro-epiploic artery at its origin.

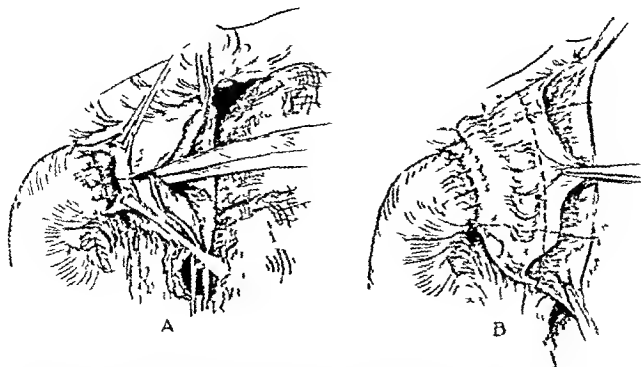


Fig 4 A, Opening of the anterior wall of the stomach B, The mucosa of the stomach is being removed and the dotted line shows the part of the stomach left for the plastic closure

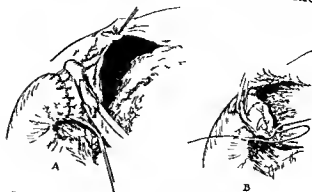


Fig 5 A Part of the duodenal muscle of the pyloric sphincter removed B The part of the stomach wall left after suturing the anterior wall of the duodenum

Clairmont has found variations from the normal in the anatomical relationships of the pancreatic ducts in 10 per cent of cadavers. The accessory pancreatic duct may be found either occluded or serving to transmit the pancreatic juice from a single part of the pancreas or to farthest that the accessory duct has been found from the pylorus. On account of distortion from the presence of an ulcer the accessory duct may frequently be found near the ulcer or in the ulcer crater itself. It is reasonable to believe that the accessory duct has frequently been ligated unsafely and without any harm when it was obliterated. It is evident that the prevention of injury to this duct depends on the same anatomical relationships as the prevention of injury to the gastroduodenal artery. Since the accessory pancreatic duct is frequently found at the upper edge of the pancreatic head the dissection of the duodenum should not be attempted farther than this landmark. Even if one succeeds in reaching the posterior wall of the duodenum distal to the deeply penetrating ulcer into the pancreas without coming in conflict with the important structures the posterior wall of the duodenum may be adherent to the pancreatic head so that its separation will cause a tearing of the muscle wall and make the closure of the duodenum unsafe.

The ulcers which are in a dangerous relationship with the common duct are usually large and deeply situated either penetrating into the head of the pancreas or into an inflammatory mass in the duodenohepatic ligament. The common duct courses posterior to the duodenum and also posterior to the small branches of the right gastric artery which are ligated and divided at the superior border

of the duodenum. After freeing the anterior wall of the duodenum from the gall bladder and mobilizing the lateral wall of the duodenum one proceeds with a ligature of the small branches of the right gastric close to the duodenum. It is frequently possible by finding the proper cleavage safely to separate the duodenum from the inflamed mass in the duodenohepatic ligament. In cases in which it is suspected that the common duct is apt to be adherent to the ulcer it is necessary to visualize the course of the common duct. As it will be pointed out later ulcers offering difficulties of this nature should best be handled in a manner which precludes any possibility of coming in conflict with and injuring the vital structures mentioned. In dealing with an ulcer on the posterior wall deeply penetrating into the head of the pancreas in which it is found that it is dangerous to free the posterior wall of the duodenum distal to the penetrating ulcer mobilization of the anterior and lateral walls of the duodenum is of the utmost importance. Failure to recognize this will result in a closure of the duodenal stump under tension with a fatal outcome. The anterior duodenal wall is opened distal to an ulcer on the anterior wall if such is present or a few millimeters distal to the pylorus and through the proximal edge of the penetrating ulcer on the posterior wall. The first row of sutures includes the proximal edge of the anterior duodenal wall and the distal edge of the ulcer. The second row of sutures is taken between the anterior wall of the duodenum distal to the first and the proximal edge of the ulcer on the posterior wall. The third row of sutures is introduced between the anterior duodenal wall distal to the second row of sutures and the pancreatic capsule which is usually thickened.

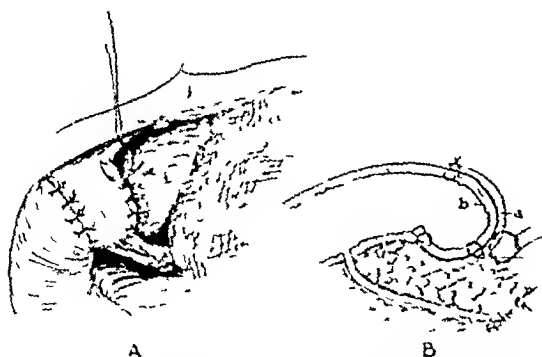


Fig 6 A, The plastic closure of the duodenal stump completed with the stomach wall sutured to the capsule of the pancreas B, Sagittal section of the plastic closure a, Stomach wall, b, duodenal wall

I have carried out this procedure successfully in 4 cases. Since in one case there was bile tinged drainage for 2 days, and in another for 10 days, it appeared to me that an improvement was needed on the plastic method of closure of the duodenum in the deeply penetrating ulcers on the posterior wall to safeguard against leakage.

For the reasons mentioned, when faced with a difficult situation, I have adopted the following method. The stomach is divided about three finger breadths above the pyloric ring and the branches of the blood vessels on the greater and lesser curvatures of the stomach are left intact. The proximal part of the stomach is protected and reflected to the left. By grasping the pyloric stump and gently putting it on the stretch, the adhesions between the gall bladder and the anterior wall of the duodenum are separated. The next step consists in the mobilization of the duodenum from the lateral side, which is very important, because one needs sufficient duodenal wall to make this plastic closure without tension. After the mobilization of the duodenum, it is necessary to manipulate it in such a manner as to assure oneself that, when inverted against the ulcer on the posterior wall, it will do so without tension. If it is found that, on account of scarring or congenital anomaly, there is not enough of the first and second part of the duodenum to cover the penetrating ulcer in the head of the pancreas, nothing has been lost, and one can proceed with the Finsterer exclusion operation. If one has the assurance that there is sufficient of the duodenal wall present the anterior wall is opened distal to the pyloric ring or distal to an ulcer on the anterior wall. The posterior wall of the duodenum is inspected and palpated to find the extent of the ulcer. The duodenum can also be palpated through



Fig 7 Plastic closure of the duodenum experimentally produced in a dog. Specimen opened on the anterior wall a, Stomach wall b, Duodenal wall c, Duodenal mucosa

the pyloric end of the stomach. If it appears that the ulcer is near the papilla, or is otherwise large or very closely adherent to the surrounding structure, the opening of the anterior wall is closed and the operation finished by the Finsterer exclusion operation. Thus, however, will not be necessary in many cases. In the majority of cases the method of approach will be as follows. After the anterior wall is opened the ulcer on the anterior wall is removed, the duodenum is incised on each side toward the proximal edge of the posterior ulcer, but not completely surrounding the crater. The crater of the ulcer is cauterized with phenol and alcohol. All parts of the duodenal mucosa around the crater are removed with a small curette. The first row of sutures consists of a half pursestring, taken on the greater curvature of the duodenum and the distal edge of the crater. The same is repeated on the lesser curvature. Two or three sutures are introduced between the anterior wall and the distal edge of the crater to complete the first line of closure. The second row of sutures is taken in the same manner between the anterior wall of the duodenum distal to the first row of sutures and the proximal edge of the ulcer. The next step consists in splitting the anterior wall of the pyloric stump, removing its mucosa, and suturing the seromuscularis over the duodenal closure. If there is too much of the pyloric stump left, a part of it is removed. The electric surgical knife is very useful and time saving. There is always plenty of mesentery and omentum to reinforce the closure if necessary.

Since the first row of sutures is taken between the seromuscularis of the duodenum and the distal edge of the ulcer, it gives a sure and easy enfolding of the anterior wall of the duodenum over and against the crater. It will also permit the escape of pancreatic juice or bile into the duodenum if there is any connection between

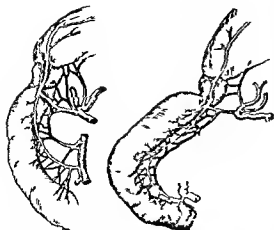


Fig. 8. The blood supply of the duodenum (From A. Henck, *Deutsche Zeitschr. f. Chir.* 1931)

these ducts and the crater. Such complications are certainly very rare. It would hardly be possible for these secretions to escape into the peritoneal cavity because the closure is not under tension and consists of several layers and in my opinion is more secure than even the typical closure of the duodenum in the uncomplicated cases. I have used this method successfully on three occasions and have also examined sections of the plastic closure in dogs at several periods after the operation. Such a closure absolutely precludes any injury to the common duct, pancreatic duct, pancreas, gastroduodenal artery or the right gastro-epiploic artery at its origin. The covering of the duodenal stump by a plastic procedure utilizing a part of the stomach wall may also be life saving in case the blood supply of the duodenal stump has been partially disturbed by the mobilization of the lesser curvature after ligation of the branches of the right gastric artery or in case the closure takes place in a fragile duodenal wall.

In any case in either of the Finsterer operations or the plastic procedure described in which the judgment might have been too hasty or in which the technique is imperative in a bleeding duodenal ulcer on the posterior wall and in which the closure does not appear altogether safe, a drain should be introduced between the closed duodenum and the stomach and surrounded and separated from the duodenum and the stomach by omental tags. The drain should be introduced through a separate incision to the right of the original one. If drainage appears on the following days and particularly if the patient complains of pain in the back, the drainage should be slightly

moved and the patient put in a Trendelenburg position (Matyas). In this manner even if a fistula develops the patient will be saved. These safeguards are mentioned to emphasize the importance of meeting an emergency which fortunately will rarely take place if one familiarizes himself with the anatomical relationships and carefully selects a safe technical procedure.

In operating for duodenal ulcer except in the presence of a perforation or acute hemorrhage one cannot jeopardize the patient's life to the same degree as in the presence of malignancy. This consideration prompts one to make a definite decision as to the choice of procedure which will make the operation as safe as the indirect surgical attack on the ulcer. I am sure that there will be no lack of criticism because the method entails a technique which does not at first appear simple. The important consideration however is the safety of the method.

#### CONCLUSIONS

The various methods of approach and the anatomical relationships as related to the deep seated ulcer on the posterior wall of the duodenum have been described.

Emphasis has been made of the importance of a thorough mobilization of the first and second parts of the duodenum particularly from the lateral side.

A new method of plastic closure of the duodenum in the difficult cases utilizing a flap of the stomach denuded of its mucosa to reinforce the closure has been described.

Such a procedure is safe and useful in some of the deep seated ulcers penetrating into the pancreas and particularly in the acutely bleeding ones in the same situation in which there is no other alternative but radical surgery when surgery is resorted to.

This method precludes any injury to the common duct, pancreatic ducts, pancreas, gastroduodenal artery or the right gastro-epiploic artery at its origin.

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## THE USE OF FASCIA LATA IN THE REPAIR OF HERNIA

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THE adequate repair of hernias is of paramount importance in industry especially is this so in the heavy industries such as represented by the steel mills, railroads and coal mines. The ordinary indirect inguinal hernia in a young adult is a condition which need cause the average surgeon very little concern.

The chance of recurrence is slight if a reasonably good repair is done and the patient is kept off work 4 to 6 weeks. There is, however, a group of hernias which owing to the type of rupture, the age or obesity of the patient, the abdominal muscular development and the type of work to which the man must return must be considered separately and due care and judgment must be exercised in their treatment. This comprises 20 to 25 per cent of all adult hernias which come to our attention and they are the type with which this paper essentially deals.

Dean Lewis, by his work in filling in gaps in torn and burned tendons with transplanted fascia, showed that fascia could be used in this manner without losing its gross and histological characteristics and in 1901 Dr. McArthur of Chicago suggested that recurrent hernias be repaired by using a strip of the aponeurosis of the external oblique. To Gallie and LeMesurier (2) belong the credit of bringing before the profession the real value of living fascial sutures. In 1921 they published a successful technique for the employment of fascial strips taken from the fascia lata as sutures in repair of recurrent and long standing hernias. This contribution and a further contribution by the same men in 1930 (3) assisted tremendously toward the better treatment of difficult hernias.

*Transplanted fascia unchanged.* Through observations on the transplanted fascia of rabbits at various stages it was shown that soon after the transplantation the surrounding blood vessels became engorged, an excess of lymph was excreted and in 3 weeks this inflammatory process had advanced to the formation of spindle shaped cells and fibrous tissue with blood vessels which had formed across the suture line. One year later there was no change in the transplanted fascia.

## INDICATIONS

*Direct inguinal hernias.* The percentage of recurrence in direct inguinal hernias is high. Erd-

man reports 16 per cent, Massachusetts General Hospital 15 per cent, Johns Hopkins Hospital 29 per cent, and other reliable observers up to 40 and 50 per cent recurrence within 2 years. Andrews and Bissell recently stated that it was useless to repair direct inguinal hernias because they caused but little discomfort, did not strangle and in many cases were worse following operation than before. This, however, has not been our experience in any respect; these patients complained considerably of pain and by the use of fascia lata we have been able to repair them satisfactorily. Direct inguinal hernias usually occur in adult males, 98 per cent occurring in males over 15 years of age. In older textbooks the statement is found that they represent only 5 to 10 per cent of hernias but in our experience 25 to 30 per cent of inguinal hernias are direct in type. They are bilateral in 45 to 66 per cent of cases. We do not feel that all direct hernias need the support of fascia to make a satisfactory repair. In the small bubonocoele type it is unnecessary and in people in sedentary occupations even though the hernia is of fair size, the repair is usually permanent without the aid of fascia lata. Age, obesity and muscular development play a part in our decision as to the type of operation needed.

*Anatomy of direct inguinal hernia.* The triangle through which a direct inguinal hernia occurs is that bounded below by Poupart's ligament, medially by the sheath of the rectus and above by the internal oblique and transversalis muscle. The successful closure of this area by tissues that will satisfactorily unite is the important step in the permanent repair of inguinal hernias. The floor of this triangle is formed by the transversalis fascia which is weakest in its mid part. The conjoint tendon is very frequently absent or almost completely obliterated. This then necessitates that the belly of the conjoint muscles rather than the obliterated or weakened conjoint tendon be sutured to Poupart's ligaments in order to effect a repair. The space which must be closed is often large and the tension on the muscles will weaken them and it is for this reason that to augment the repair with fascia lata is of great benefit.

*Large indirect inguinal hernias.* This type of rupture in a patient past middle life in a strenuous occupation needs the soundest repair possible. This is especially so if the man is obese. Ab-



Fig 1 Double interrupted catgut sutures (left untied) placed between conjoined tendon and the shelving edge of Poupart's ligament

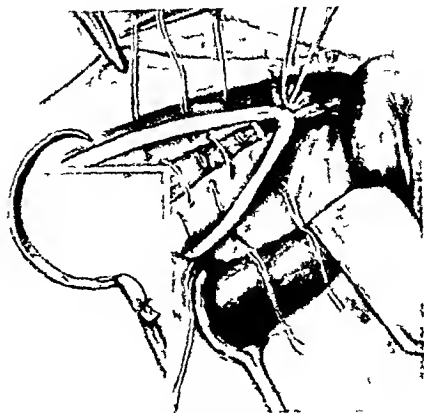


Fig 2 Inset shows needle threaded with fascia Fascia is being sutured at lower end of incision

#### TECHNIQUE OF REPAIR OF DIRECT AND LARGE INDIRECT INGUINAL HERNIAS

dominal musculature poor, or if he is afflicted with a complication such as chronic bronchitis. In these cases there is not only the peritoneal protrusion through the muscles of the indirect hernia, but also a weakening of the whole posterior wall.

*Recurrent inguinal hernias, direct or indirect* If for some reason the sac is left in place in an indirect inguinal hernia, recurrence will take place within a few weeks of return to work. If a hernia remains repaired for 2 years and then a lump appears at the site of the original operation, I believe that we may consider it a new hernia. Those in which a sac has been removed and yet a hernia occurs within a few months, need the addition of fascia lata in their repair, because obviously the muscles of the posterior wall are too weak to stand the necessary strain. In those cases in which a new hernia develops at the site of an old one, fascia lata should certainly be used in the second operation, because there must be a congenital or acquired muscle weakness.

*Ventral hernias—incisional* These do not include umbilical hernias as these are satisfactorily taken care of by a Mayo repair, but the post-operative hernias, especially following a suppurating abdominal incision usually have a wide defect and need all the reinforcement possible. The very large majority of this type of hernia can easily be brought into apposition and satisfactorily repaired by the use of the fascia lata strip. There are, however, a few extensive abdominal wounds or long standing incisional hernias in stout people that require the patch transplant as described by Gallie and LeMesurier in 1930.

It has been well demonstrated that a fascia to fascia union of the tissues is much more durable than a muscle to muscle union or a muscle to fascia union. The interposition of fat at the suture line is also detrimental to firm union, therefore, throughout the operation a conscientious effort must be made to clean the approximating tissues of all fat or damaged muscle. The usual Bassini repair is made with the cord transposed above the external oblique. Double interrupted catgut sutures are placed between the conjoined muscles, the remnants of the conjoined tendons and the shelving edge of Poupart's ligament. A loop stitch is used in order to approximate both the body and margins of the structures to be brought into apposition. The sutures placed both above and below the internal ring are left untied until the introduction of the fascia lata. While this part of the operation is going on, an assistant has procured fascia lata from the opposite thigh, a double strip 14 inches long, each arm of the strip  $\frac{3}{4}$  inch wide and left untied by a small square of fascia at the lower end. This is thoroughly cleaned of fat and muscle and threaded and tied with linen on Gallie needles. The double strip of fascia lata was devised by Murray and, in our experience, is more efficient than the single strip as first suggested by Gallie. The strength of the repair depends upon the amount of healthy fascia properly placed at the line of union and, with the double strip, the lower united end of fascia lata is placed in that most vulnerable position for recurrence, just above the pubic bone. The two needles enter the shelving edge of Poupart's ligament, and the conjoined muscles respectively just above the



Fig. 3. Fascia lata patch.



Fig. 4. Fascia suture completed around hernia.

pubic spine and the fascia lata are used as suture material crossing over the junction of the two structures in a manner resembling the football stitch. As the fascia progresses upward the double catgut sutures are tied, holding the fascia lata in place. Tension is not taken by the fascia lata but by the catgut sutures. The fascia is threaded in and out around the internal ring and above the ring it is carried upward in the same manner as below the ring. In our series of cases we have not found it necessary to bring the fascia lata down the external oblique muscle as advised by Gallie and Le Mesurier. The usual closure is made of the external oblique muscle, subcutaneous tissues and skin. The fascia lata of the thigh is closed in every case.

In the ventral hernia a similar technique is used; the muscles are approximated and a liberal amount of fascia is employed. In large

hernias of any type but more especially the ventral type a patch transplant is used.

#### TECHNIQUE OF PATCH TRANSPLANT OF FASCIA LATA

When the protrusion of peritoneum is so great that it is impossible to approximate the muscles satisfactorily in any type of hernia then the patch transplant is indicated. In the very large majority of cases the hernias necessitating this procedure are incisional hernias. In their repair the scar tissue is excised; no attempt is made to separate the layers of the abdominal muscles and the peritoneum is left unopened. The muscles are then undercut for  $\frac{1}{2}$  inch around the margins of the hernia and the whole is cleaned of fat and muscle fragments. A piece of fascia lata of required size usually about 5 by 3 inches is removed from the thigh and no attempt is made to close the defect in the thigh.

The edges of the fascia are cut into strips  $\frac{1}{4}$  inch wide made sufficiently long to be brought through the thick hernia margins and overlap in the center. These tails are then tied and their knot is sutured with catgut. The subcutaneous tissues and the skin are closed over this. It is sometimes necessary to use two patches of fascia and if so these patches are sewed together with a fine  $\frac{1}{4}$  inch strip of the same material. If this patch transplant is used in a large inguinal hernia the fascial sheet should extend above the internal ring and the cord is allowed to enter the abdomen between two tails of the fascia lata.

During the  $5\frac{1}{2}$  year period from January 1, 1929 to July 1, 1934 we operated upon 740 hernias at this clinic. In this group we felt it

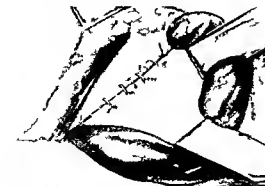


Fig. 5. Hernia repair with fascial transplant.

necessary to transplant fascia lata from the thigh to supplement the hernia repair in 101 cases. This comprises 13 per cent of hernias and this percentage probably would have been larger but for the fact that many of these herniorrhaphies were in children. Our satisfaction with the operation is shown by the fact that we are doing proportionately an increasing number of fascia transplants to prevent recurrence. Of these 101 hernias, the large direct inguinal hernias comprise 74, the large indirect type, 17, and ventral incisional hernias, 10 in number. Of all of these different types 24 patients had previously been operated upon by ourselves or someone else, and recurrence had taken place.

#### RESULTS AND COMPLICATIONS

*Recurrences.* The very large majority—about 90 per cent of these patients were employees of subsidiaries of the United States Steel Corporation and consequently a check-up by the company surgeons was easily accomplished. There were no fatalities, and all of these men had been returned to their usual employment, of the 101 cases, recurrence had taken place in only 7 by December, 1935, which is 18 months after the last herniorrhaphy accounted for in this series. When it is taken into consideration that no hernia was turned away without operation except on account of other physical defect, that many of these were in men over 60 years of age and that the men were returned to hard active labor, that descriptions of their hernias included such terms as "has recurred twice before," "has been refused operation due to size of hernia," or "totally incapacitated due to size of hernia," then we feel grateful that we have this very excellent supplement in the repair of hernia.

In more detail the recurrences were as follows:

1. Two recurrences in the same man who was operated upon for double direct hernias. Only one single strip of fascia was used on either side and it is felt that if a double strip had been used

his chances of permanent repair would have been better.

2. One ventral incisional hernia which discharged some purulent material and fascia following the operation.

3. One direct inguinal hernia which did likewise.

4. A ventral hernia in the lone woman operated upon for a huge hernia which had occurred following a wide transverse abdominal incision, in whom it was necessary to do a patch transplant to effect a repair. She became pregnant and 6 months later was thrown over a trolley seat in a street car accident with immediate recurrence of the hernia.

5. One direct inguinal hernia in which there is a small recurrence just above the pubic spine, evidently due to insufficient fascia lata.

6. One large direct inguinal hernia in which there was some discharge following operation.

All of these except one have submitted to a second fascia transplant and been satisfactorily repaired.

*Infection and necrosis.* In 10 per cent of cases there was a seropurulent discharge from the incision sometimes accompanied by the protrusion of fascia. Three of these cases had a recurrence of the hernia.

*Double testicular atrophy* occurred in a recurrent double direct inguinal hernia but was probably unrelated to the introduction of the fascia lata.

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## COW HORN FIXATION IN BONE SURGERY

## ITS USE IN FORTY CASES

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IN 1934 Fowler<sup>1</sup> reported the use of cow horn as a fixation material in fractures. In Dr Fowler's quoted bibliography there is evidence that cow horn is a keratin substance containing large quantities of cystein. Cystein was shown by Hammett and Reimann<sup>2</sup> to stimulate growth by causing increased mitosis. Cystein has been shown to stimulate granulation tissue in old chronic ulcers by Brunsting and Simonsen.<sup>3</sup> Dr Fowler's 9 clinical cases with 21 others which he had collected from the literature notably from the clinic of Lexer and Boharsky would seem to indicate that this material has properties which might stimulate bone repair and otherwise provide a fixation material useful in holding the position of fragments.

Impressed with these reports and in the observation of some of Dr Fowler's personal cases I decided to give the method a trial. I had no difficulty in finding Texas longhorn material.

**Preparation.** The horns are secured fresh from the packing house and with the aid of a hack saw and an emery wheel are cut and ground into various shapes. Horn nails in different sizes and lengths are found most convenient.

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Fig. 1. Left. Compound fracture of femur repaired with cow horn nail. Right. Compound fracture of femur repaired with cow horn nail.

**Sterilization.** Specimens were autoclaved 30 minutes, 40 minutes, 1 hour and 1½ hours and all were negative after 5 days incubation. The technique we have followed for clinical use is as follows: The nails and pegs are boiled for 1 hour before sending to the surgical division. They are again autoclaved with the instruments and supplies in the routine set up for the operation. Repeated sterilization adds to the brittleness but while moist either from the recent boiling or when remaining in contact with living tissue retain their normal flexibility. After several boiling they are discarded for pressure specimens.

**Tensile strength.** Results of experiments show a unit strength of cow horn to be 13,000 pounds. For comparison iron has 60,000 pounds and piano wire 80,000 pounds. Boiling does not reduce the tensile strength. Cross strain resistance increases rapidly with the size of a peg. When moisture is increased and the breaking point occurs at approximately 50 degrees of bending through leverage action.

**Absorption rate.** We have had occasion to remove cow horn pegs and nails from clinical cases at various periods after reduction and since the reaction is at variance with some published reports a history of the specimens will be given in some detail.

**Case.** Fact. The patient is a 35-year-old male, a carpenter by occupation. He was injured while working on a roof and fell from the edge. He sustained a compound fracture of the right femur. The fracture was treated by reduction and fixation with a cow horn nail. The patient was discharged on the 10th day.

**Case.** A 45-year-old male, a farmer by occupation. He was injured while working in a field and fell from a horse. He sustained a compound fracture of the left femur. The fracture was treated by reduction and fixation with a cow horn nail. The patient was discharged on the 12th day.



Fig 2 Fractured tibia 6 months after cow horn plate and nails had been applied for fractured leg (3 weeks in mal position) Non union—plate and nails removed for bone graft Absorption of cow horn material approximately 25 per cent



Fig 4 Fractured shaft of humerus 3 months after open reduction (fracture 5 weeks old in malposition) Fixation by intramedullary pegs



Fig 5 A Fractured clavicle Open reduction with intra medullary cow horn pin fixation Union in 6 weeks



Fig 5 B Left Fractured condyle 4 months after injury—non union B, Same, 4 months after replacement of fragment and fixation with single cow horn nail Union firm Note epiphyseal change Same type fixation indicated in early fractures with better prognosis.





The cystein content of the specimens removed after remaining 6 months in bone tissue was 13.75 or approximately 75 per cent of normal horn tissue

These clinical observations indicate that cow horn is tolerated by bone tissue as a foreign body and is very slowly absorbed. With the slow rate of absorption and the slow release of cystein it is not believed that the material is of any definite value in stimulating bone union. However, it is well tolerated and does not appear to influence unfavorably the processes of repair.

On the assumption that it is well tolerated and slowly absorbed we have continued to use horn tissue in certain types of fractures because of its adaptability as a fixation material. Either nails, rods, plates or slabs have been used to fix fragments in more than 50 cases. The method has been applied to the clavicle, humerus, radius, and ulna and around the processes near joints. There have been 2 cases of non-union, one of them a clavicle, and the other the fractured tibia here reported. The position held in the described fractures has been fair only from the lack of firm fixation in an accurate reposition. In one forearm fracture the ulna was fixed accurately with a removable screw and the radius less perfectly with a cow horn peg, yet the radius was firmly united 2 weeks earlier than the ulna.

For fractures around joints such as the condyles and malleoli the method is most adaptable. In 3 instances a fractured internal malleolus separated and in non-union has been freshened and fastened back with a horn nail followed by rapid union. In 2 instances the head of the radius has been re-attached to the shaft by means of a small flat head, horn nail. The nail head was counter sunk

beneath the cartilage and did not interfere with function. In the application of nails, the drill hole is made of the same size and length as the nail. If necessary the length of the nail can be altered by cutting the end and resharpening. A generous head is left for impacting into the bone. A nail so applied maintains tension apparently as well as a steel nail. In 10 instances we have used horn nails in conjunction with autogenous bone grafting. The autogenous graft of the onlay type is fastened with horn nails. The results have been satisfactory. One of my associates, Dr. Girard, has designed a unique horn anchor for fresh fractures in the neck of the femur. He has used it in 2 instances with rapid union.

#### SUMMARY

1. Horn material is adapted for many uses in bone surgery.
2. It can be formed into slabs, plates, straight or curved rods, and nails.
3. It has a high tensile strength and yet enough flexibility for easy application.
4. Specimens are sterilized by 30 minutes of boiling but 1 hour of preliminary boiling advisable.
5. When placed in bone tissue, absorption is very slow, probably 8 to 12 months. It is tolerated by the tissue as a harmless foreign body.
6. The release of cystein is so slow that it is of doubtful value in stimulating bone repair. The fracture will be united before the cystein is released or in case of delayed union any good effect which the cystein might have would probably be overbalanced by the other factors which have been the cause of the delayed union.

## THE PRODUCTION OF VACINAL ACIDITY BY ESTRIN

ITS IMPORTANCE IN THE TREATMENT OF GONORRHEAL VAGINITIS

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D p m t fB l 3 3 l L l

THE successful results reported in the use of estrin in the treatment of gonorrheal vaginitis in children aroused our interest and led us to try to determine more definitely the manner in which a gonococcal infection is terminated by a temporary change in the vaginal mucosa as a result of endocrine therapy. It has been suggested that the exfoliation of the epithelium resulting from such treatment might aid in throwing off the organisms. It has also been suggested that the formation of a zone of cornification in the functional layer of the mucosa prevented penetration of the gonococci and so resulted in a cure.

For many years the acidity of the adult vagina has been recognized as inimical to the gonococcus. Kelly, for example, in his *Medical Gynecology* (1908) mentions this fact. Hall and Lewis (1936) found that the normal vaginal secretions of immature monkeys measured by a potentiometer was definitely alkaline, hydrogen ion concentration 7.580. After hypodermic treatment with estrin the secretions became strongly acid, hydrogen ion concentration 5.457. Four weeks after the treatment with estrin was discontinued the secretions became again markedly alkaline, hydrogen ion concentration 8.688. In view of the well known fact that *in vitro* the gonococci grow best in an alkaline medium and usually do not survive if it is rendered acid below a hydrogen ion concentration of 6.0, the suggestion was made that a change of reaction to acid of the vaginal secretions of children with estrin similar to that found in monkeys might easily account for the destruction of the gonococci. We believe that such is the case, basing our opinion on the observations reported later in this paper.

Many years ago Doederlein called attention to the importance of the acid secretions of the vagina as a mechanism of defense against intra uterine infections. He believed that the presence of the acid-forming bacteria, which later were named for him, accounted in a great measure for the vaginal acidity, which is in such extraordinary contrast to the alkalinity of the cervical secretions. It has since been shown frequently that the vaginal acidity often destroys a pathogenic organism which

may be introduced into the vagina, particularly during pregnancy.

Since Doederlein's discovery, attention has been focused on the importance of the glycogen-containing cells lining the vaginal mucosa in rendering the secretions acid. These cells form lactic acid as they break down, partly as a result of enzymatic action and partly as a result of the activity of acid-producing bacteria.

Cruckshank and Shorman (1934) have given an admirable review of the observations made on the histology, glycogen content, acidity, and bacteriology of the vagina at all periods of life. When estrin is present, i.e., at birth and very shortly after, as well as from puberty to the menopause, one invariably finds that the vaginal mucosa is made up of many layers of glycogen-containing cells. The reaction of the secretions is typically acid and normally the bacterial flora is predominantly of the bacillary type. In the absence of estrin during childhood and after the menopause, one finds a thin vaginal mucosa with few layers of cells, an alkaline or nearly neutral reaction of the vaginal secretions, and a mixed flora consisting essentially of cocci.

The figures published in various observations of measurements of the vaginal acidity noted at different ages vary somewhat, probably because different techniques were used in making the determinations. All observers agree, however, that the marked acidity of the vaginal secretions between puberty and the menopause is in sharp contrast to the slight alkalinity or nearly neutral reaction during childhood. Regardless of the method employed to measure the hydrogen ion concentration, the general differences in acidity during these life periods has been found to be strikingly similar.

In order to determine the reaction of the vaginal secretions, we used 1 or 2 cubic centimeters of sterile physiological salt solution adjusted to hydrogen ion concentration 7.0. This was expelled into the vagina from a sterile pipette and withdrawn several times to get a fair sample of vaginal washings. The hydrogen ion concentration of a drop of these washings was easily deter-

mined, the following color indicators being used in their respective ranges, brom-thymol-blue (pH 6.0-7.6), brom-cresol-purple (pH 5.2-6.6), and brom-cresol-green (pH 4.0-5.6). A number of the readings obtained with the use of these color indicators were checked with electrical determinations of the hydrogen-ion concentration, and the results corresponded remarkably closely. For the physician treating a case of gonorrheal vaginitis, this method is easily applicable for determining whether or not the estrin reaction has occurred. It is carried out as follows: a drop of brom-thymol-blue is added to a drop of vaginal washings obtained by the method just described. An immediate change to a deep yellow indicates that the fluid being examined has an acidity very near or greater than hydrogen-ion concentration 6.0. If the resulting color is a very light green or shades into a heavy green or light blue the reaction is more alkaline than hydrogen-ion concentration 6.0. This method is much more rapid and more easily carried out than is the examination of microscopic sections of biopsies or stained smears. We have compared all three methods and have found that when the colorimetric determination of the vaginal hydrogen-ion concentration indicates that it is 6.0 or below, the vaginal mucosa is found to have responded well to the treatment with estrin.

In a series consisting of 17 normal children, the youngest of whom was aged 4 months and the oldest 10 years, we found the vaginal secretions to have an average hydrogen-ion concentration of 7.2. The lowest value obtained was 7.0 and the highest 7.4. Cruickshank and Sharman (1934) studied a series of children in the same age group as those observed by us and found that the average hydrogen-ion concentration ranged between 7.4 and 7.8. In only one of our cases in this group were Doederlein's organisms demonstrable in culture. This child was 10 years old and had a vaginal hydrogen-ion concentration of 7.4.

In 10 children with gonococcal vaginitis measurements of the vaginal acidity gave an average hydrogen-ion concentration very near the neutral point. The individual readings obtained are as follows: hydrogen-ion concentration 7.0, 7.0, 6.8, 6.4, 7.2, 6.8, 7.4, 7.2, 7.2, 7.4. Tissue destruction as evidenced by the presence of pus probably explains some of the lower figures in this group. Cultural examinations of the vaginal washings for the Doederlein organism were negative in every one of these cases.

In Table I are shown a group of 11 consecutive cases of vaginitis in which *N. gonorrhoeae* was still present in smears and in which the vagina was

TABLE I—TREATED CASES OF GONOCOCCAL VAGINITIS, SMEAR STILL POSITIVE

Case	Smear for gonococcus	Duration of treatment	pH	% Doederlein organisms
1	+	6 days	6.6	0
2	+	1 wk.	6.8	0
3	+	1 wk.	6.6	0
4	+	1 wk.	6.4	0
5	+	1 wk.	6.4	0
6	+	2 days	7.0	0
7	+	3 wks.	6.0	0
8	+	1 wk.	6.8	0
9	+	?	6.4	0
10	+	18 days	6.4	0
11	+	5 wks.	6.2	0

found to have a hydrogen-ion concentration of 6.2 or more. They had all been treated by inserting gelatin capsules containing 75 r u of amniotin into the vagina at night, just before retiring. No other treatment was given. It will be noticed that in all but one case amniotin had been given for a short time only. Comparison with the hydrogen-ion concentration figures given for the untreated cases shows that the vaginal secretions were already being rendered acid. As a rule approximately 2 weeks of such treatment will result in a vaginal acidity of hydrogen-ion concentration 6.0 or below. One patient failed to produce the usual vaginal acidity even after 5 weeks of treatment. This is rather unusual and may be due either to failure to insert the amniotin capsules (or suppositories) into the vagina regularly, or to some individual idiosyncrasy of the patient's response to the hormone.

Table II shows clearly the effect of amniotin in producing a strongly acid vaginal secretion. It will be noticed that, in this series of cases, all of the hydrogen-ion concentration determinations made before treatment was begun were alkaline (between pH 7.2 and 8.0). Every one of these patients was apparently cured when the last hydrogen-ion concentration determination was made. In no case in which the vaginal secretions were found to have a hydrogen-ion concentration of 6.0 or below for any length of time could the gonococci be found in the smear.

In Cases 10 and 11 the vaginal secretions became smear-negative without the production of a strongly acid reaction. Occasionally, under any or no form of treatment, probably as a result of a local tissue immunity, patients with gonococcal

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TABLE II—CASES OF GONOCOCCAL VAGINITIS SUCCESSFULLY TREATED WITH AMNIOTIN

Case	Age years	Sm f gonococci before treatment	Diff time t	Duration of treatment (days)	Sm f d d re m	Smear for g or act during treatment	Discharge or mucus for retest
		+	3	5	8	ne	
		+		5	6	bill pers ts	
	3	+		5	8	ne	
		+		7	5 8	neg	
3	3	+		5	5 6	—	
4		+	2	5	6	+	
5		+	4	5	5	neg va	
		+		3	7	+	
		+		8	6	—	
6		+		8	8	—	
		+		5	6 6	+	
7		+		5	8 8	—	
8	8	+	7		6	+	
		+		6		—	
		+		3 8	8	neg live	
	3	+	3 8		4	neg	
		+	7	3	7	ne	
		+			6	neg va	
		+			8	neg f	
		+	3 8			neg li	
		+	8	5		neg f	
	3	+		8		ne va	
		+			3	neg va	
		+			8	neg va	
		+				neg	
		+		5		neg	73
8		+		6		ne va	73
		+				ne	73
20		+				neg	73
		+				neg	73
		+				neg	73

vaginitis recover quickly and spontaneously. We believe that this occurred here.

In several instances a number of determinations of vaginal acidity were made during the course of treatment. The results are shown in Table II. Special attention is called to Cases 2, 5, 6, 8 and 9. Usually the smears remained positive until the vaginal secretions were no longer acid than hydrogen ion concentration 0.2. They then promptly became negative.

It is interesting to note that relatively few cultures showed the presence of the Doderlein organism. Occasionally this bacterium was found to be present when the vaginal reaction remained neutral or faintly alkaline.

## CONCLUSIONS

1. The administration of estrin to children renders the vaginal secretions strongly acid.
2. This acidity of the vaginal secretions is in

all likelihood the important factor concerned in doing away with gonococcal infections, when children so infected are treated with estrin

3 The acidity of the vaginal secretions is easily measured and gives easily obtained reliable proof that estrin therapy has brought about the desired histological reaction of the vaginal mucosa

4 Doederlein's organism was present in only a few of the children examined and its presence or absence could not be correlated with the acidity or alkalinity of the vaginal tract

We acknowledge with appreciation the assistance given us by Dr Eleanor H Adler We are indebted to her for

generous contributions of her time and skill in making a considerable number of the hydrogen-ion concentration determinations which appear in the tables in this article Dr C Hendee Smith was also most kind in allowing us access to the patients in the Children's Medical Service of Bellevue Hospital, Department of Pediatrics, New York College of Medicine The majority of the patients examined and reported on in this paper were from this service

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## PREPARATION OF SAFE INTRAVENOUS SOLUTIONS<sup>1</sup>

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THE production of a reliable supply of parenteral fluids in otherwise adequately equipped hospitals has been hindered by the lack of simple apparatus in which chemically pure solutions can be dispensed safely and economically The technique to be described employs apparatus designed to provide easy sterilization, safe storage under hermetic seal, and ready administration from the original container

Fear of the symptom complex "intravenous reaction" has discouraged many from using parenteral fluids Despite convincing evidence as to the real cause of such reactions, clinicians are loath to abandon individual susceptibility, impurities from chemicals, rubber, and glassware, the velocity of injection, or the volume, temperature, or hydrogen-ion concentration of the injected solution as the etiological factors Pyrogenic substances, chiefly bacterial toxins, have been demonstrated as the responsible agents (1, 3, 5, 6, 7, 8, 9, 13) Chemically pure, sterile solutions injected into the vein will not cause untoward reactions (4, 10)

There are but two fundamental requisites for a safe supply of parenteral fluid—an unlimited source of freshly distilled water and centralized responsibility for cleanliness in the preparation of the solutions and apparatus

Singly distilled water from a still equipped with adequate baffles and traps or with a refluxing condenser is safe (1, 2, 4, 10) Sufficient water for immediate use is best collected in pyrex carboys

(Fig 1) These carboys must be sterilized by flushing with live steam from the still prior to collecting the distillate and must be drained dry after use, since distilled water can be stored only when sterile and sealed

The pyrex glassware used in preparing the solutions is washed with hot soapy water and rinsed with tap water It is then filled with a cleaning fluid composed of 10 per cent potassium dichromate in dilute sulphuric acid to remove adherent fungi and grease from the inside of the flasks and to leave the pyrex chemically clean After 12 hours the fluid is poured off and the glassware rinsed thoroughly with 8 successive small quantities of distilled water (Fig 2) The glassware is then inverted to drain and must be used within 2 hours or recleaned

Isotonic sodium chloride solution (0.85 per cent) is prepared from a fresh stock solution made by adding distilled water to 170 grams of chemically pure sodium chloride<sup>2</sup>, previously weighed out in a counterbalanced flask, until a net weight of 1,108 grams has been reached The flask is stoppered with a clean rubber stopper and shaken until solution is complete This stock solution is then filtered through a fritted glass filter,<sup>3</sup> with the aid of suction, directly into a 300 cubic centimeter pyrex burette (Fig 1) Fifty cubic centimeters of the filtrate are measured into a counterbalanced short necked, thick

<sup>2</sup> Merck's and Mallinckrodt's contain least particulate matter

<sup>3</sup> Jena fritted glass filter No 17 G 4

<sup>1</sup> Read at the combined meeting of The Boston Surgical Society and The Philadelphia Academy of Surgery on February 3, 1936

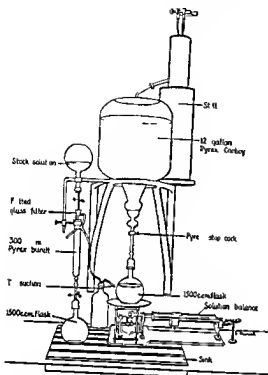


Fig 1 Air g m n t f a p p a t i f a c i l i t a t e t h e p r e p a r a t i o n o f p a r e n t e r a l f l u i d b y a t e c h n i q u e w h i c h a d o s m a s s f i t i n d h u m e r i c t r a s f f i s d

walled pyrex flask and distilled water is added to a net weight of 1049 grams. A clean rubber bushing is fitted into the mouth of the flask; its skirt is turned down and the channeled stem of the steel stopper (rr) is partially inserted into the bushing (Fig 3 A). The channel in the stem

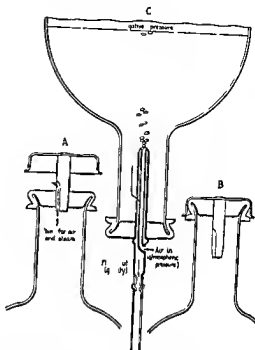


Fig 3 H e m e t i c a l p a r e n t e r a l f l u i d a d m i n i s t r a t i o n f r o m t h e o r g a n i s m s c a p e f a n d s t a m d n g s t h e a u t o c l a v e C A i r e n t r s t h c a p i l l a r y r f i e t h e e n e g a t i v e s p e s s u r e w h a n t h e t e d f l a s k B A a c u m u l a t e d b y t h e g a s t r a p p e d t o t h e b u s h i n g a n d p e r m i t t e d t o e s c a p e

provides for the escape of air and steam during sterilization. The solutions are sterilized immediately in an autoclave at 250 degrees F for 15 minutes. After sterilization the steam supply to the autoclave is shut off and the autoclave permitted to cool to 200 degrees F before it is opened. In this way concentration of solution resulting from the ebullition of steam that follows sudden relief of pressure is avoided. As the flasks are removed from the autoclave the steel stoppers are pushed in to complete the seal (Fig 3 B). Sufficient vacuum forms during cooling to produce a water hammer when the flask is jarred thus providing a ready check on the sterility of the solutions. If the autoclave pressure has been relieved too soon the hiss of the steam as it rushes through the channel in the steel stopper warns the operator that the solutions have been spoiled. The sterile sealed solutions can be stored indefinitely without impairing their value as safe parenteral fluids.

T m y t u r f i t h s o l u t i o n t o t e l l ( )

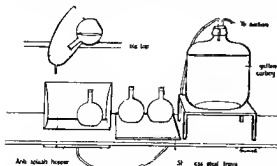


Fig 2 C l o s e f l a s k d i s p h e d t h e f l a s k f r o m t h e c a b y A f t e r h a s t h e f l a s k e m p t y b y t r a n s f e r r i n g t h e m i n t e r i a l f l u i d w h i c h t h e d i s t r i b u t i o n c a n b e c o n t r o l l e d

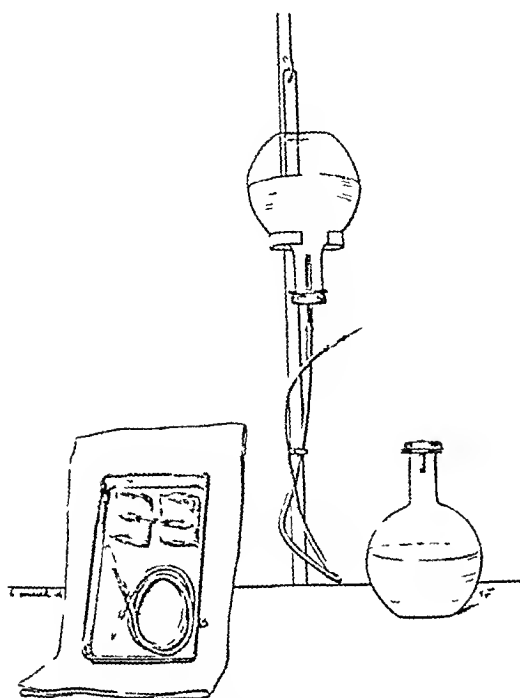


Fig 4 Apparatus for the administration of parenteral fluid, preparation, sterilization, storage, and administration of fluid are accomplished in individual flasks. The necessary glassware, tubing, and needles are sterilized in a central supply room.

To prevent contamination of non-pyrogenic fluid, the utmost cleanliness of the inside of the tubing and needles is essential. The "bloom" is removed from new rubber by treating it with 5 per cent sodium carbonate solution in an autoclave at 250 degrees F (Fig 5, A), for 30 minutes. The rubber is then rinsed with 1 per cent hydrochloric acid followed by distilled water. Care must be taken that the inside of the tubing is full of solution, otherwise the inner surface, which comes in contact with the parenteral fluid, will not be properly cleaned.

After use on the ward, the apparatus is washed with cold water and returned to the central supply room, where it is cleaned immediately prior to sterilization. All the parts are separated and washed thoroughly with hot soapy water and rinsed in cold tap water for 30 minutes. The inside of the parts must be thoroughly cleaned. The glassware is immersed in the acid cleaning fluid for 12 hours and then rinsed thoroughly with distilled water. The tubing is coupled together with glass connectors and boiled for 45 minutes in a 0.5 per cent solution of sodium hydroxide.

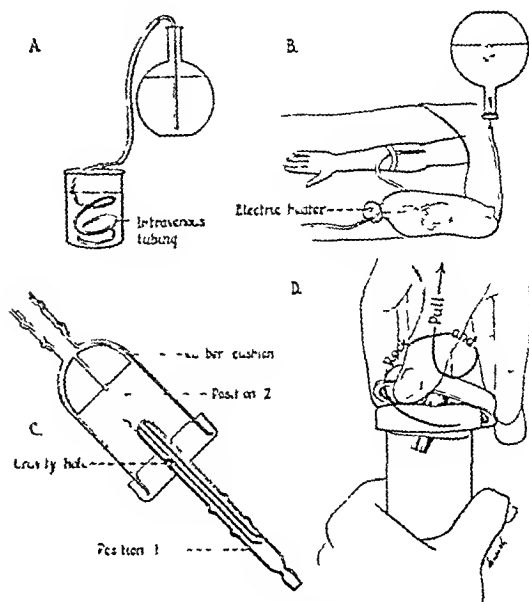


Fig 5 A, Method of providing continuous flow of alkali through the rubber tubing during cleansing. This apparatus can be set up inside an autoclave as well as over a hot plate. B, Method of heating the solution if desired. Heat applied elsewhere has little effect. C, The pyrex vent tubes are easily cleansed by sucking freshly distilled water through them. In position 1 the gravity outlet is occluded while the air tube is rinsed, at 2 both passages are cleansed. D, the stainless steel stopper is readily removed by a rocking, spiral motion.

The alkali, from a convenient reservoir, is run through the tubing continually during the boiling (Fig 5, A). After the tubing is cool, distilled water is run through it for 30 minutes. The needles are washed in hot soapy water and rinsed in distilled water. The parts are dried on a clean, dust free sheet with the aid of suction, and assembled. The needles, without stylets, are placed in an hourglass tube plugged with loose cotton. This equipment is arranged in a clean aluminum pan (Fig 4) wrapped in a double-thickness muslin sterilizing envelope and autoclaved for 15 minutes at 250 degrees F. If the sets are not used within 10 days they must be resterilized.

The fluid is administered from the original container by removing the steel stopper with a rocking, twisting motion (Fig 5, D). An inrush of air as the stopper is removed assures the user of the sterility of the contents of the flask. A pyrex vent tube is then pushed into the hole in the rubber bushing as far as the shoulder. This tube acts as a capillary valve for the admission of air as the solution leaves the flask by gravity.

TABLE I—DIRECTIONS FOR MAKING DIVERS SOLUTIONS

S l	Ch m l	tock sol t	Net ock sol gm	amt added flask m	V t flask gm
s pe t d t se d l l d t	m d t one p		35		
t t d t d t l l d w t	m d t se p.		55		83
85 pe t sal	7 gm sol m h d p		8	5	10
s pe d t rose s pe l	(1) m f t rose p (b) 7 gm sol m h d p		5	00	006
pe t d t se 85 pe t sal	(1) gm d t rose p (b) 7 gm sol m h d p		5	00	8
R ng	gm potass m h d p 7 gm l m h d p 008 m sol m h d p		5	5	115
s pe d t rose	00 gm d t rose p.		6		
s pe t se se	m one		5		

All an h been m d l s pe l h d g t h d

(Fig 3 C) The flask is inverted and hung in the split ring bracket. The rubber tube and needle are filled with solution and the infusion may be started (Figs 4 and 5).

More than 1000 cubic centimeters of solution may be given by substituting a second flask as the first one is emptied. This is done by clamping off the rubber tube with a Hoffman clamp prior to removing the vent tube and reinserting it into the bushing of a fresh flask of solution.

If a sufficient supply of sterile sets of pyrexvent tubes, rubber tubing and needles are kept on hand the solutions are instantly available and rational parenteral therapy is constantly at the disposal of the clinician.

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t no ject ns Am J l d y L 10 5 62  
7 Idem W l b S b t n z n e euge f i bet ach  
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## DIFFUSE CAVERNOUS ANGIOMA OF THE LEG

FREDERICK C. KIDNER, M.D., F.A.C.S., DETROIT, MICHIGAN

**H**EMANGIOMA or angioma, as we shall call it in this paper, in contrast to lymphangioma, is an overgrowth and dilatation of blood vessels, which are abnormal in character. These vessels have certain neoplastic characteristics and may at times assume malignant qualities. Angioma is distinguished from the ordinary dilatations and overgrowths of vessels seen in varicose veins, granulation tissue, and highly vascular cellular tumors, by the fact that the latter are the responses of normal vessels to disease or to the demands of the body for greater local blood supply, which disappear when the demand ceases. They are of three types: (1) simple angioma, (2) plexiform angioma, (3) cavernous angioma. Simple angioma, the common nevus, is a congenital dilatation and overgrowth of the capillaries of the skin. It does not grow but may be the starting point for deeper vascular tumors. Plexiform angioma is a congenital overgrowth of the skin capillaries and venules in which the vessels grow in length and thus pile up nodules which may acquire considerable size. They grow but do not infiltrate or destroy other tissues. Cavernous angioma is a congenital overgrowth, hypertrophy, and dilatation of abnormal vessels which tend to grow and infiltrate the surrounding tissues. According to Ewing they undoubtedly have their origin in a developmental anomaly in the structure of certain vascular segments which do not fit into the general circulatory system but retain embryonic characteristics. This thesis is developed by De Takats. He insists that these vascular tumors are not true growths, but are due to faulty development of the blood vessels themselves, and that the variations in the tumors depend upon the amount of differentiation from the embryonal type. They may occur in many parts of the body: in the liver (7), in bones, particularly the bodies of the vertebrae, in joints (9), and, somewhat rarely, in skeletal muscles. It is to the discussion of cavernous angioma of the skeletal muscles that this paper is devoted.

## OCCURRENCE

These tumors occur most frequently in persons under 30 years of age. In 1930, Davis and Kitlowski collected 212 cases of cavernous angioma of skeletal muscle from the literature, and reported several of their own. In 1932, Jenkins and Delaney found 61 additional cases in the literature

and reported one of their own, but eliminated 18 of Davis and Kitlowski's cases, giving a total of 256 cases reported up until 1932. I have found one more reported case (11) and herewith present 4 of my own. In the reported cases, muscles in the various parts of the body are about equally affected, although there is a slight preference for the lower extremity. All of my cases occurred in the lower leg. This is in contrast to an analysis of 1,674 angiomas of all types (10) made in 1924, in which only 9 per cent were in the lower extremity.

## PATHOLOGICAL ANATOMY

These tumors are essentially a dilated mass of thin walled blood vessels lined with endothelium and supported by a delicate stroma of fibrous tissue. These dilated vessels arise from capillaries, arteries, or veins, probably through a process of endothelial hypertrophy which leads to blocking of the lumen of the vessel, which in turn causes back pressure and dilatation. New vessels are constantly added by proliferation of endothelium into bud-like processes which grow and form channels into which blood pushes. These new vessels, in turn, dilate to add to the mass of the tumor. In parts where active growth is taking place, the tumor is very cellular and the new vessels cannot be recognized. In these areas there is an actual shortage of blood supply or anemia. The connective tissue supporting stroma may vary greatly in amount. On the amount of this connective tissue depends the consistency of the tumor. Thrombosis of the dilated vessels frequently occurs and this is followed by organization with formation of dense masses of fibrous tissue. This process may be so widespread as to halt the growth of the tumor. Many of these tumors are encapsulated, in which case they are relatively harmless and are readily removed. If they are unencapsulated, or break through the capsule, they are capable of extremely diffuse growth and much destruction of surrounding tissues. Myelated and unmyelated nerve fibers and embryonic lymphoid tissue sometimes appear in the tumor.

The anemia caused by endothelial proliferation at the edges of the tumor cuts off the blood supply of the muscles which are being invaded, and they degenerate and are gradually replaced by the tumor. In the encapsulated common type, this process does not go far, but in the unencapsulated, infiltrating, and relatively rare type, the muscle

destruction is widespread may be penetrated and nerves invaded or even destroyed as in the case of Stewart and Bettin. Even the bones may not escape the effects of these infiltrating tumors. Irritative periosteal thickening, pressure atrophy, and actual invasion of the medulla by the tumor substance occur. (2) Whether or not the tumor actually invades the larger blood vessels is still under discussion, but the fact that in one of my cases and in the case of Bell and Ingles the posterior tibial artery could not be identified at operation or autopsy would seem to indicate that it does. This infiltrative and destructive process may go so far as to necessitate amputation.

The clinical course of the infiltrating non-encapsulated cavernous angioma is an insidious one. The first sign of its presence is usually an ill-defined soft swelling which may appear at any time after birth. This may remain stationary for a long time or may grow steadily. Sometimes an injury may be followed by more rapid growth. Frequently in its early stages this swelling is unaccompanied by symptoms. As the mass grows symptoms and signs appear which are dependent on the morbid anatomy of the particular tumor. The first symptom usually is pain. This pain is of three types: (1) a feeling of fullness and heaviness with a stretching sensation which is caused by distention of the blood spaces within the tumor. This type of pain is relieved by rest and elevation of the limb by which the tension within the vessels is reduced. (2) A radiating pain similar to the root pains of severe sciatica which is caused by pressure on or infiltration of the nerves themselves. This pain is often so severe as to cause loss of sleep and inability to use the limb and is accompanied by protective spasm of the muscles. It may or may not be relieved by rest and elevation. (3) The third type is extreme sensitiveness to touch or pressure and is probably caused by irritation of the new nerve tissue which sometimes grows within the tumor. It disappears when the limb is protected from trauma. The second most common symptom is muscle weakness. This is dependent on the actual destruction of muscle tissue and varies with the amount of that destruction.

Swelling is the most common objective sign. This swelling may be soft and compressible, decreasing with elevation of the limb or it may be firm and non-compressible. It is subcutaneous or subfascial. It is within the muscle substance. If the swelling is painful or tender there is protective muscle spasm. Engorged superficial veins or varicose veins often overlie the swelling. The skin may be hot and red.

The roentgen ray appearance of these tumors is misleading because in the roentgen ray the soft parts show only swelling in most cases while the bone changes, whether periosteal thickening, localized enlargement or local atrophy are not characteristic. Occasionally the roentgenogram may show a mottled appearance of the soft parts suggesting gas in the tissues. This is produced by the large blood spaces in the more vascular tumors. The bone changes are those of periosteal thickening, cortical thickening or of pressure atrophy.

Diagnosis is difficult in most of the cases. It should be based on the history of the case as to the time of the appearance of the tumor and its duration on its early lack of symptoms on its gradual growth and on the gradual appearance of the symptoms detailed. Physical examination should reveal the fact that the tumor is intramuscular. If it is large when the limb hangs down and decreases in size when it is elevated its nature should be suspected. The softer and more compressible the tumor the more likely it is to be an angioma but often the tumor is hard and firm because of the large amount of fibrous tissue it contains. Differentiation from diffuse lipoma from fibroma from sarcoma from aneurysm and from multiple neuroma must be made.

#### TREATMENT

Treatment of angioma of muscle is difficult. In the simple encapsulated type surgical removal is comparatively easy as shown in the case reported by Kleinberg. If however the removal is not complete recurrence may occur. In the diffuse type the difficulty of successful treatment is evidenced by the numerous methods which have been advanced. Coagulation by the injection of chemicals has been tried with success in small tumors but in the large ones the difficulty of reaching all parts of the tumor and the dangers of necrosis and poisoning have led to its abandonment. Cauterization by the electric cautery has failed for similar reasons. Long continued pressure in the hope of thrombosis of the mass has never succeeded. Roentgen ray and radium although apparently successful in the treatment of cavernous angioma of the vertebral bodies have not yet proved their value in the muscle tumors. Surgical removal offers great technical difficulties because the tumor is so widespread and involves so many tissues and because of the very real dangers of hemorrhage. I have found few reports of successful surgical removal of a large tumor. On the other hand amputation has been resorted to frequently. (10) Nevertheless I believe that

surgical removal of the tumor, perhaps in more than one stage, is feasible and offers the patient an excellent chance for a useful limb.

The following cases are presented in support of this belief, to accent certain pathologic features of the tumors, to present a little more evidence in support of the theory that they are congenital neoplasms, and to protest against the belief that they always recur.

**CASE 1.** R. S., female, aged 24 years, an only child. She was first seen on June 1, 1919. The family history was irrelevant. The past history showed that as a young girl she had been very active but never robust. About 1911, she had a fall while skating, which she thought bruised her left leg. Some time later she developed a "growth" on the calf of the left leg which was removed by another surgeon. The report of this operation was not obtainable but the patient thought that the growth consisted of varicose veins. The operative area had been tender ever since and had swollen from time to time. During the past year she had worn a bandage on the leg in an attempt to relieve the sense of fullness and "dragging" but this had done little good. The trouble with the leg had greatly restricted her activities because of the discomfort and because of weakness of the calf muscles. She had noticed varicose veins in the back of the leg.

There was nothing abnormal found in her physical examination except the condition of her left leg. This showed several large varicose veins extending upward on the outer and posterior surface from mid calf to mid thigh. The left calf was 1 1/4 inches larger than her right. This enlargement was due to a soft compressible tumor which lay beneath the fascia and seemed to involve most of the bellies of the gastrocnemius and soleus. It was 6 to 7 inches long. It was not tender or painful. The skin over it was not discolored. There were no hard areas in it and it could be made to disappear completely by steady pressure. Operation was advised for the removal of the tumor, which was thought to be a cavernous angioma.

Operation, January 12, 1920, under ether anesthesia. A long external incision in the calf down to the deep fascia revealed nothing abnormal. The fascia was opened and a huge mass of greatly distended, thin walled vessels presented. The mass did not pulsate and apparently replaced muscle. The vessels tore very easily. They appeared to open into each other in all directions like the structure of a sponge. Considerable parts of the muscle substance were intact and appeared to be pushed aside by the growth. Other parts were infiltrated by it. In order to gain better control of the tissues, a second internal incision was made and a mass of tumor and involved muscle, 7 by 2 1/2 inches, was dissected out. No one vessel could be found which supplied blood to the tumor nor one which emptied it. The posterior tibial vessels were not exposed nor was the nerve. During the removal of the mass there was much hemorrhage, mostly venous, which was controlled by pressure. The remaining good muscle was then sutured over the dead space left by the removal of the tumor. The skin was closed with silkworm gut and a large pressure bandage and splint were applied. It was impossible to hold the foot at right angle flexion because of pressure anemia and pain. Moderate shock was successfully combated by saline hypodermodyesis. There was no secondary hemorrhage.

Following this operation gradual restoration of function was secured, but two small secondary operations for removal of remnants of the tumor and adjacent varicose veins were necessary within the succeeding 6 months. The



Fig. 1. Case 1. Blood vessels of leg surrounded by tumor growth. (Left at 1 possibly vessel bud.)

patient has remained well since, has two children, is moderately athletic and has no symptoms. There has been no recurrence of the tumor and both legs are equal in size, which gives her satisfaction.

The pathological report by Dr. Plinn H. Morse is hemangioma cavernosum. The growth diffusely infiltrates the muscle and surrounds the blood vessels, in some places producing pressure on and constriction of the original blood vessels. As a result of this mechanical effect, thromboses are produced within the vessel walls, which later fenestrate and resemble somewhat the original tumor growth (This may explain the illustrations in the article of Jenkins and Delancy. These seem to show actual invasion of a blood vessel by the tumor). There are some nerve filaments in the sections.

This case is the most typical of our series. It exemplifies the type of pain or discomfort which is due to distention. Speculation as to whether the accompanying varicose veins were coincidental or whether they were a part of the tumor is intriguing. I am inclined to believe that they were coincidental because they were superficial to the fascia, whereas the tumor was beneath it.

**CASE 2.** Female, aged 10 years, was first seen on June 3, 1931. The family history was irrelevant. The family had known since the child's birth that she had "flat foot" on the left, which was due to congenital malformation of the tarsus. It gave her no trouble until 4 years ago when she had scarlet fever. Immediately thereafter she began to have pain in the left lower leg and to limp. The pain has continued since. It varied in intensity but was generally severe and kept her awake at night. It was burning in character. Pressure, as from a shoe, relieved it somewhat. She slept with the foot pressed against the wall and she liked to keep the leg elevated. The foot was "feverish." About a year ago a "lump" appeared in the left calf.



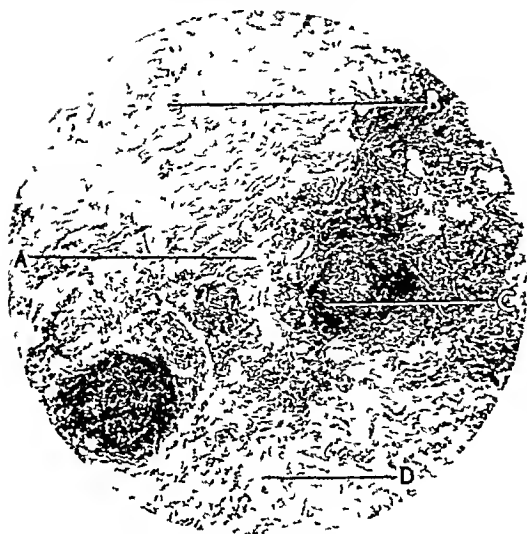


Fig 6 Case 2 Marginal portion of tumor showing compression and atrophy of muscle cells in the zone around *D* Fragmented muscle fibers with attempts at regeneration at *A* New forming lymph tissue at *C* Muscle at *B* more nearly normal except for increased fat tissue



Fig 7 Case 2 New forming lymph nodes at *A* Multiple dilated spaces as at *B*

incision was made from mid thigh to lower third of the calf. The external popliteal nerve was first explored in the lower third of the thigh where the sciatic divided. Dissection of the external popliteal nerve revealed, about 2 inches above the head of the fibula, a mass of fibrous tissue and distended blood vessels which infiltrated the nerve, greatly enlarging it for about 2 inches. Below that the nerve was normal. This dissection established the outer border of the tumor, which was firm but filled with large distended blood spaces. The tumor lay under the gas trocnemius, infiltrated the soleus, and was densely adherent to the back of the tibia and interosseous membrane. It extended from the popliteal space to the Achilles tendon. In order to identify and preserve the internal popliteal and posterior tibial nerve, it was necessary to dissect it completely from above, downward, through the mass of the tumor. The tumor did not invade this nerve but was in contact with it. No posterior tibial artery could be found, nor could any vessel of entry or exit be made out. The whole tumor was removed with most of the soleus. The tumor of the external popliteal nerve was carefully dissected, much of it being removed without damaging many nerve fibers. Tourniquet was removed and hemorrhage was controlled by pressure and suture. The wound was closed without drainage. Dry dressing and a plaster cast were applied with the foot and knee in corrected position.

After the operation this girl received two deep roentgen ray treatments. Six weeks later the spasm of her ham strings and dorsiflexion of the foot had disappeared, so that her knee and ankle could be normally controlled. All pain in the leg disappeared but moderate pain in the foot has persisted, as has the dilatation of the foot veins, the heat of the foot and the desire for pressure as a relief from pain. The pain is now limited to an area, 3 by 3 inches, on the inner side of the sole of the foot. Following operation, there developed a thrill in the engorged area in the foot which could be heard as a loud bruit with the stethoscope. This must be due to an arteriovenous connection. Since 1932,

when amputation was advised elsewhere, frequent attempts to obtain permission for further operation in the foot area have been made. The parents have just now consented.

Pathological report on this case was cavernous and telangiectatic hemangioma including many primitive lymph nodes and many small nerve fibers running through the tissues. The tumor in the external popliteal nerve was vascular and fibrous.

CASE 3. M. G., male, aged 39 years, laborer, was first seen in Out Patient Department on June 25, 1933, because



Fig 8 Case 2 Older portions of tumor showing multiple nerve filaments scattered through hyaline connective tissue as at *A* and *B*



Fig 9 Case 3 Dissection at peritoneal cavity on the right side of the abdomen. The patient is lying on the table, and the surgical team is visible around the operating area.

For a right-sided tributary below the knee. He had a history of pain in his right leg for several years. The pain was described as a sharp, stabbing pain, and it was often worse at night. The patient had a history of smoking and drinking, and he had been a heavy worker. The pain was described as a sharp, stabbing pain, and it was often worse at night. The patient had a history of smoking and drinking, and he had been a heavy worker.

Physical examination revealed a normal male, 45 years old, with a body mass index of 25. The right leg was slightly enlarged (inches). The enlargement was due to a soft, firm mass, possibly a tumor. The mass was located in the right leg, and it was slightly enlarged. The patient had a history of smoking and drinking, and he had been a heavy worker.

Operative findings: The right leg was slightly enlarged (inches). The enlargement was due to a soft, firm mass, possibly a tumor. The mass was located in the right leg, and it was slightly enlarged. The patient had a history of smoking and drinking, and he had been a heavy worker.



Fig 10 Case 4 Tumor of the right leg. The patient is lying on the table, and the surgical team is visible around the operating area.

Immediately after the patient's paroxysmal pain disappeared, and he returned to his normal state. The patient had a history of smoking and drinking, and he had been a heavy worker.

Case 4: T. Z. male, aged 33, was first seen in 1935. The patient had a history of smoking and drinking, and he had been a heavy worker. The patient had a history of smoking and drinking, and he had been a heavy worker.

Physical examination: The patient had a history of smoking and drinking, and he had been a heavy worker. The patient had a history of smoking and drinking, and he had been a heavy worker.



Fig 11 Case 4 Telangiectatic hemangioma of muscles of calf. Large blood spaces as shown at A indicating character of tumor growth



Fig 12 Case 4 Typical field of angiodysplasia invading calf muscles. Note lymphocytic infiltration and multiple nerve fibers at A and B

enlargement of the bone at that point. The swelling was extremely sensitive, and this tenderness extended upward through the gastrocnemius muscle. A diagnosis of cavernous angioma was made and operation was advised as the proper treatment.

Operation was performed November 4, 1935, gas and ether anesthesia, tourniquet. A long posterior incision over the gastrocnemius was made. The deep fascia was penetrated here and there by small dilated vessels which connected with deeper tissue. The fascia was split, exposing a widespread mass of large, dilated, thin walled vessels with much dense, supporting fibrous tissue which was, in many parts, extremely cellular, suggesting sarcoma. This infiltrated the gastrocnemius and soleus as well as the peronei and was densely adherent to the fibula. The vessels supplying this mass invaded or came from all surrounding tissues. The tibia was thickened, apparently by the irritation of the tumor. Very wide dissection was carried out but it was impossible to surround the tumor completely. It was removed as nearly completely as possible. Because of the extreme vascularity of this tumor and its connections, the dissection was carried up through the popliteal space, thus exposing the internal and external popliteal nerves and the popliteal artery which were surrounded, but not infiltrated, by the tumor. This was cleared so that it could be clamped readily if the bleeding should be too severe after the removal of the tourniquet. On removal of the tourniquet, bleeding was profuse, mostly from small arteries which had entered the tumor from all directions. These could not be tied but were controlled by pressure while a very rapid suture of the muscle and fascia was done. Meanwhile, intravenous 10 per cent glucose had been started. In spite of rather severe shock, it was possible to close the wound and apply a pressure bandage without tying the popliteal artery. The boy was in poor condition for 12 hours but reacted well with the aid of glucose and morphine. The circulation in the leg and foot was good. After 10 days the sutures were removed on November 30. Induration and tenderness are still present and the out-

come with reference to function and pain is still to be determined.<sup>1</sup>

The pathological report was cavernous angioma of muscle. There are many small nerve filaments running through

<sup>1</sup>This child returned for examination on March 5, 1936. He is entirely free from pain. There is still a little tenderness at the middle of the calf. Fibrous tissue substitution at the site of operation has led to a slight shortening of the Achilles, which prevents dorsiflexion of the foot beyond the right angle. Motions of the knee are normal and the boy is beginning to walk. He is still wearing a plaster splint at night.



Fig 13 Case 4 Organized portion of hemangioma, showing nerve fibers at A and B

the mass and a mass of lymphoid tissue with small germ cells present. There is some degree of cellular change.

Operative removal of cavernous angioma has proved feasible though difficult in these 4 cases. In Case 1 minor secondary operations were necessary but there has been no recurrence in 15 years. In Case 2 the first operation gave great relief and removed the bulk of the tumor which has not recurred in 4 years. Secondary minor operations are necessary. In Case 3 surgical destruction of the tumor apparently was completely successful. In Case 4 removal of the tumor although not complete was 90 per cent successful. The pain in Case 1 was due to distention and was of the first type of pain. It was completely relieved. The pain in Case 3 was of the second or nerve root type and was due to pressure on and invasion of the nerves. It was completely relieved by operation. The pain in Case 4 was of the third type and was due to the pressure on sensory nerves in the tumor. It was not relieved. The pain in Case 2 was a combination of the second and third types. It was completely relieved in areas from which the tumor had been removed.

The presence of nerve filaments and young lymphoid tissue in the tumors of Cases 2 and 4 puts these 2 cases without possibility of doubt in the class of congenital tumors arising from abnormally developing embryonal tissue. Both

tumors are preponderantly cavernous angioma. The cavernous angioma microscopically in Case 1 and macroscopically in Case 3 exactly resembles that in Cases 2 and 4. This resemblance is a very striking evidence that the tumors in Cases 1 and 3 are congenital in origin.

I am indebted to Dr Philip Mose for his report of the pathological findings in the material and for advice from the pathologist.

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A SIMPLE TECHNIQUE FOR THE CURE OF HYPOSPADIAS<sup>1</sup>

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THE term "hypospadias" was originally coined by Cruikshank. However, it has been known about its origin until the development of embryology, and most of the early literature is concerned with unusual effects related with this deformity. Hypospadias is a condition of the penis and urethra caused by a failure of fusion of the ventral folds which normally roll together in the male embryo by the end of the tenth week. The genital ridge is essentially the same in both the male and female up to the eighth week. After that, it is rapidly takes place in the male as indicated in Figure 1.

It is not an inherited condition being present in, according to Rennie and Bensson, in 1 out of every 200 males. A very distinct hereditary tendency has been shown by Lillard who traced generations in which transmission has occurred from father to son. He stated that in Normandy, many degrees of hypospadias frequently run in families.

The anomaly varies from a slight almost imperceptible defect (Fig. 1) to a complete absence of the penile urethra and epiaurodermiphrenic appearance (Fig. 2). For clinical purposes it is only necessary to differentiate 3 types: (1) glandular or bulbous, (2) penile, (3) scrotal, and (4) penile.

Indications for operation vary in proportion to the distance of the opening from its normal location. In the bulbous type there is never a real indication for operation although, according to Keyes, even the slightest degree is sufficient to prevent admission to West Point. With this defect in the glans, or just behind it, the patient can urinate normally and his ability to procreate is in no way affected. Many of the patients are unaware of their deformity but occasionally the mere knowledge produces an obsession amounting almost to a psychosis. Such a patient should not be operated upon, and he can usually be dissuaded when all the facts have been presented. It may be a harder task to convince an over-solicitous parent (especially a doting mother).

In the penile type the defect may occur at any point from the glans to the base of the penis. The opening may be slit like in a transverse direction, ovoid or round, and occasionally the openings are multiple. Whenever such a patient finds it necessary to sit or squat to urinate, he is very greatly handicapped and should be given the benefit of

a plastic repair. The gratitude of the patient with a scrotal or penile defect when restored to anything like normal more than justifies the expenditure of patience and meticulous care necessary to obtain a good result.

I have examined over 15 different operations. The mere fact that so many methods have been suggested indicates that no operation has been entirely satisfactory. Diefenbach is usually credited with having done the first operation, but perusal of his original report shows that no one of his cases is cured. Anger, in 1874, employing practically the Ingersoll method, apparently obtained the first successful result (4). Most operations depend upon one of the following principles:

1. The lateral flip principle, that is, some modification of the Duplay and Ingersoll operations (Fig. 3). Excellent results have been obtained by this method, but it requires complete diversion of the urinary stream. It is also fol-

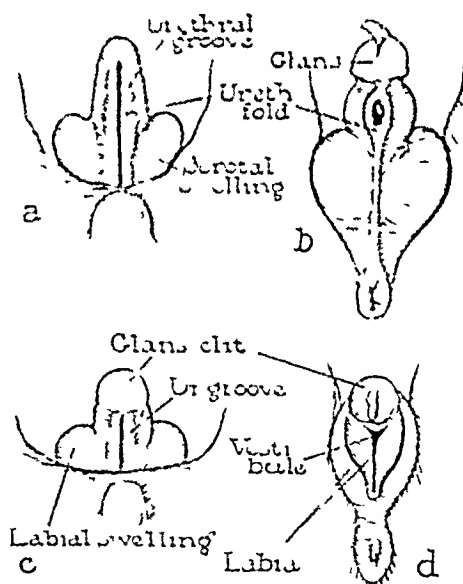


Fig. 1. a, Male embryo at 8 weeks showing the open urethral groove. b, Male embryo at approximately 12 weeks, showing closure of the groove and development of the glans. c, Female embryo at 8 weeks. Note similarity to a. d, Female embryo at 12 weeks, showing development of vestibule.

<sup>1</sup>From Cook County Hospital, Chicago, Illinois. Read before the Western Surgical Association, Rochester, Minnesota, December 7, 1933.



Fig. 3. Perineal hypospadias. The slit scrotum and pseudomphallotomy.



Fig. 4. Perineal hypospadias. The slit scrotum and pseudomphallotomy.

lowed in some instances by the formation of a fistula which may require several operations to close.

2. The Bucknall principle which consists in suturing the penis to the scrotum and obtaining scrotal skin to line the under surface of the urethra. Cabot has used this method for years and finds it almost fool proof although he has recently raised the objection that the transplanted hair bearing epithelium may later become the source of trouble.

3. Some modification of the Beck principle that is freeing the urethra and carrying it through the glans (Fig. 5). This method can be used only in those cases in which the opening is anterior to the scrotum and is almost certain to result in a permanently deformed organ.

4. The employment of the prepuce either as a flap as in the Ombredanne method (Fig. 6) or as a tube such as the method originally described by Wood (quoted by C. H. Mayo) the Mayo method or the Russell.

5. For a limited number of cases in which the defect is not too great the inverted umbrella flap described by Bevan in 1917 gives excellent results (Fig. 7) and it is this principle which I have utilized in repairing more extensive defects.

Most of these methods require a cystotomy either suprapubic or perineal. Although infection rarely follows vesical drainage in children it can not be denied that there is certain added risk from such drainage and stricture of the perineal urethra must occasionally follow especially if Young's method of constriction of the urethra distal to the perineal urethrotomy be employed.

The method which I wish to present is based upon well established principles both in plastic surgery and in the treatment of hypospadias. It does not require cystotomy and its simplicity is

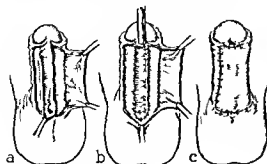


Fig. 5. The Beck operation mobilizing the urethra and bringing it through the glans penis.

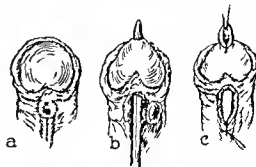


Fig. 6. The Ombredanne method mobilizing the prepuce and bringing it through the glans penis.

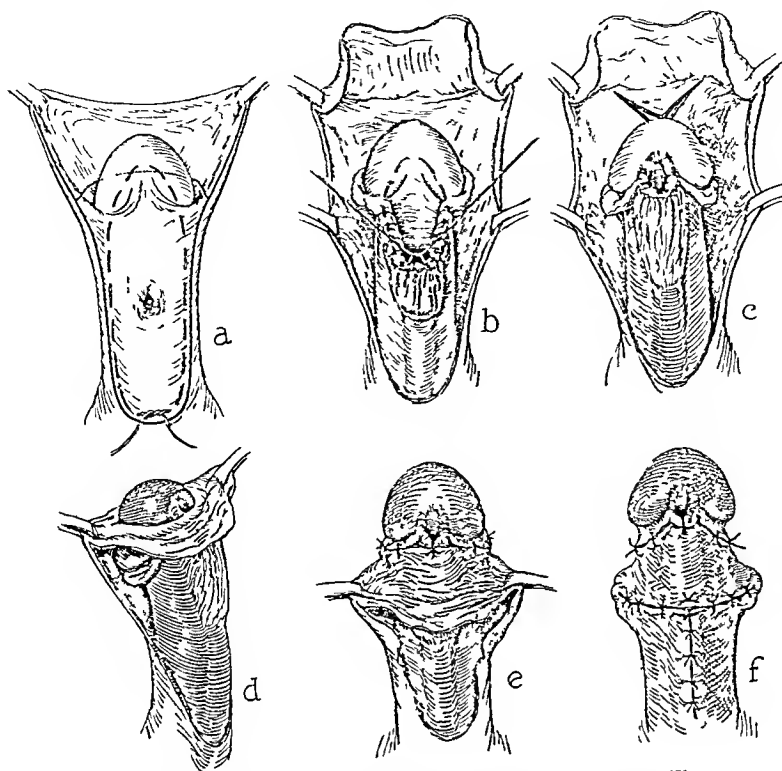


Fig 6 The Ombredanne method of repair of perineal hypospadias The raw surface left after making the new urethra is covered by prepuce which is split, c, perforated, and carried over the glans, d It is then sutured on the under surface of the penis as indicated in e and f

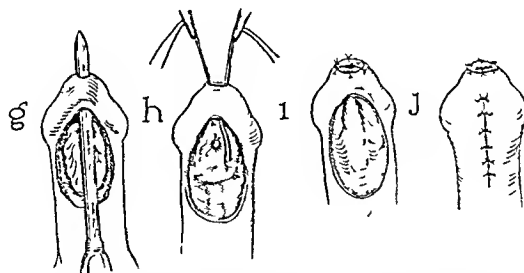


Fig 7 The Bevan method of repair of perineal hypospadias—used in completing the operation diagrammed in Figure 6

its greatest recommendation In the event of failure, the patient's condition is no worse than before operation There is no question but that the correction of the chordee is an important preliminary step to any corrective operation As stated by Cabot, the ideal time for this preliminary step is very early, that is, at the age of 2 or 3

However, many of these patients are first seen at 8 or 10 Even at this age a transverse incision followed by careful dissection of Buck's fascia and the removal of *all* the fibrous bands which produce the shortening (Fig 8) will largely correct the deformity While the resultant defect is a little startling at times, there is never any diffi-

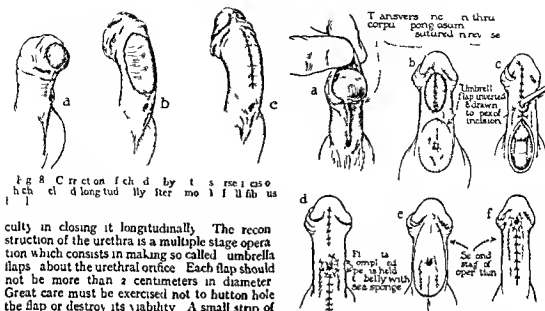


Fig. 8. Multiple stage operation employed in the treatment of scrotal defect in hypospadias.

cult in closing it longitudinally. The reconstruction of the urethra is a multiple stage operation which consists in making so called umbrella flaps about the urethral orifice. Each flap should not be more than 2 centimeters in diameter. Great care must be exercised not to button hole the flap or destroy its viability. A small strip of the lining of the new channel distal to the urethral orifice is not elevated so that the blood supply of the remainder is not impaired. For this dissection I use a special small curved dissecting scissors resembling a miniature pair of Mayo scissors. The lumen of the new urethral orifice is narrowed by a few interrupted sutures of fine silk. The raw surface of the new urethra is then covered by suturing together longitudinally the skin edges of the defect from which the flap was taken (Fig. 9). Success depends largely upon the care with which the dissection is made and hemostasis carried out.

Accurate approximation should be done with interrupted sutures of fine silk. The advancement at any one stage is not great but is sufficient to give the patient very definite improvement. In most instances I have introduced a soft rubber catheter into the bladder leaving it 4 or 5 days. Even when it has been expelled earlier the result usually is good. Following the operation the wound is dressed with gauze and a moist sea sponge is applied to hold the penis flat on the patient's abdomen as suggested by Wilray Blair. The stitches are removed from the seventh to the tenth day and the patient is discharged from the hospital but kept under observation. Most of these patients can be operated upon during their vacation time so that about a year elapses between stages. When they return the induration has entirely disappeared and the skin is just as soft and pliable as before the first operation. One may now repeat the operation carrying the urethra another step forward. In most instances

two or three stages are all that is necessary. In 3 instances I have carried the flap through the glans after making a channel with a trocar as suggested by Dr. Bevan (Fig. 7). In 2 others I have employed the Ombredanne flap (Fig. 6) for the final stage.

At the present time I have 5 completed operations performed on patients suffering from defects of the penile and scrotal type with what seem to be satisfactory results. I also have 4 other cases in various stages of repair. Whether these results will be as satisfactory when these patients reach manhood remains to be seen. Although one boy now 17 operated on 5 and 4 years ago has a very excellent result and has been changed from a bashful sensitive child into a perfectly integrated youngster. I have as yet no complaints of difficulty following inversion of hair bearing scrotal skin. Davis has suggested the use of the roentgen ray to prevent this complication but I should be afraid of damage to the testes as well as the hardening (fibrotic) effect upon the skin. Soft pliable skin is an essential factor in any reconstruction operation.

#### SUMMARY

A simple multiple stage operation is suggested for correction of the more extensive types of hypospadias based upon well established plastic prin-

ciples It does not require cystotomy The results have been satisfactory to date, although it is too soon to know whether there may be late objections such as have been reported by Cabot, Walters, and Counseller, Churchman, Vermooten, and others

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## SURGICAL CORRECTION OF FLEXION DEFORMITY OF THE KNEES DUE TO SPASTIC PARALYSIS

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WHEN the surgeon sees a patient with spastic cerebral paralysis, the damage has long since been done, and the opportunity to help is largely limited to amelioration of the symptoms While treatment of the cause has so far been unsuccessful, the treatment of the effect of this condition offers many possibilities Some simple surgical procedures often make it, in some instances, possible and, in others, easier for these patients to walk

These spastics have such lack of co-ordination of their motor power that the stronger muscles overpull their weaker antagonists, and the typical deformities, such as equinus, knee flexion, adductor contracture of the thighs, etc, develop

The extremely awkward appearance and the difficulty of walking with the knees flexed 20 degrees or more have led to many attempts to correct this handicap Partial division of the nerves to the hamstrings, lengthening or division of the hamstrings, transplant of the hamstring tendons into the patella, have all been tried with posterior capsulotomy of the knee joint at times Each of these procedures in certain instances may be of benefit

Several years ago we were impressed with the idea presented in a paper by Chandler dealing with this question of knee flexion deformity in

spastics Chandler discussed the subject of knee flexion in spastics, described his ingenious operation, and reported his original case

In every spastic who has had knee flexion since birth, the ligamentum patellæ and the quadriceps are stretched The patella rides well above the joint line at or above the epiphyseal line instead of having its lower border at the joint margin Even if the flexion deformity is corrected by any means, the overstretched muscle is at a mechanical disadvantage and can not efficiently work to maintain extension Therefore it seems extremely logical to take up the slack in the quadriceps extensor by transplanting the tibial tubercle into the tibial shaft 1 inch to 1½ inches distal to its normal insertion

On some of these patients we have performed a posterior capsulotomy of the knee joint and have also found it necessary to paralyze the hamstrings temporarily by dissection of the sciatic nerve and injection of its branches to those muscles with alcohol

In fixing the tibial tubercle at its new site, we originally used an ordinary nail and silk suture, removing the nail 3 weeks after operation More recently we have varied this procedure by transfixing the ligamentum patellæ with an autogenous bone peg and then suturing the periosteum



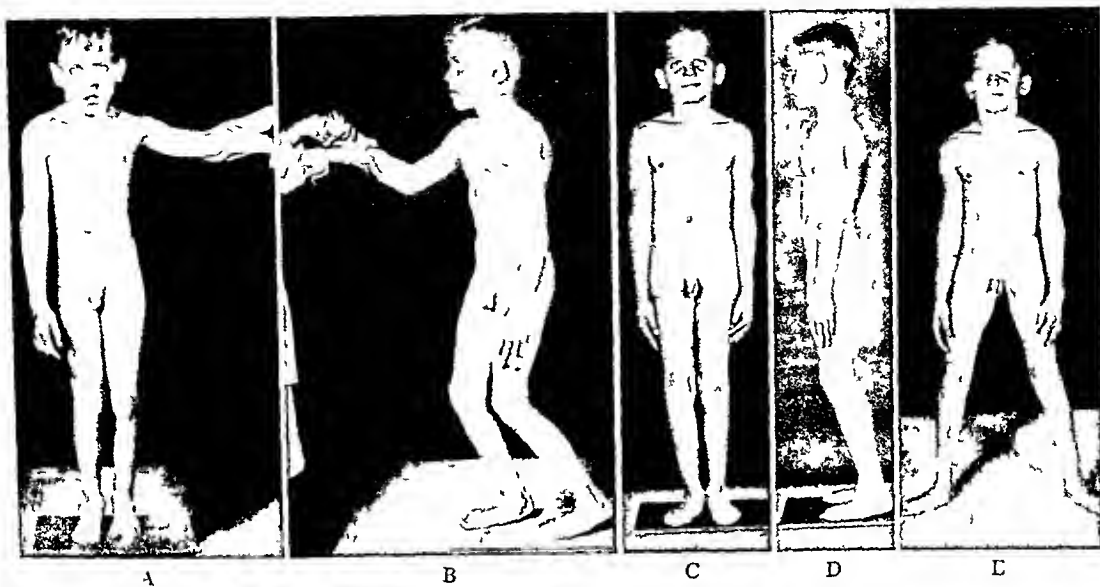


Fig 3 Case 1 Photographs before and after operation

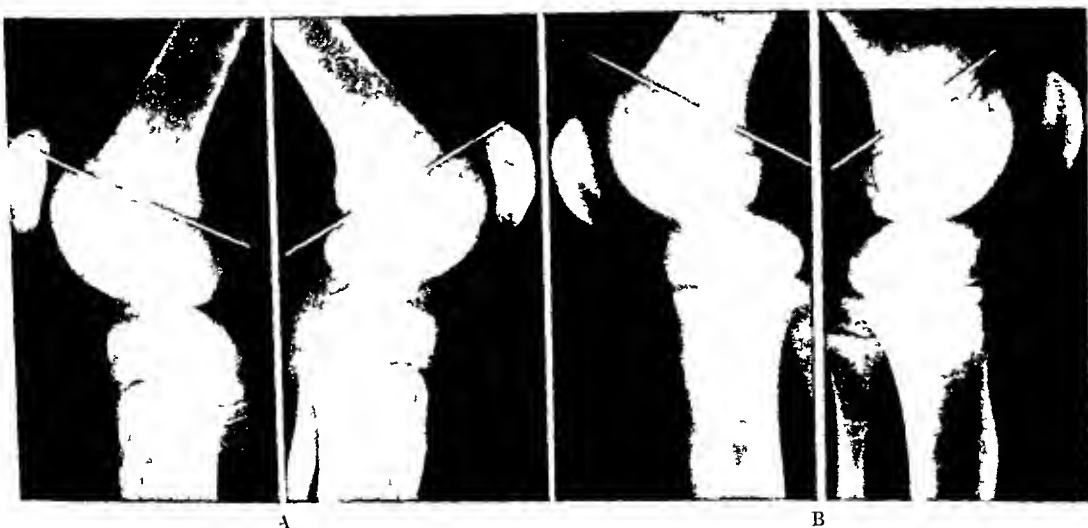


Fig. 4 Case 1

30 degrees The knees were stretched, and plaster-of paris circular splints were applied on January 23, 1933  
On February 13, 1933, a bilateral tibial osteoclasia was done  
On March 27, 1933, the nerves to the right and left hamstring muscles were injected Plaster of paris splints were applied with the knees fully extended and the legs widely abducted  
His postoperative course was uneventful, and he was discharged in May, 1933 He was attempting to walk with stiff leg braces on both legs, but he was unable to do so

without support He went to the Convalescent Hospital until December, 1933, but his walking was extremely difficult because of his 20 to 30 degrees of knee flexion  
He was readmitted to the St. Luke's orthopedic service January 10, 1934, on account of his knee flexion deformity There was marked relaxation of both patellar ligaments and the lower borders of the patellae were situated an inch or more above the joint line  
On January 15, 1934, a bilateral transplantation of the tibial tubercles was done, a block of bone with the ligamentum patellae attachment into the tibial shaft being inserted

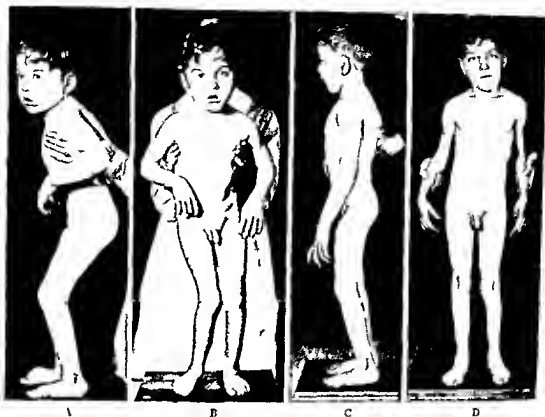


Fig 5 Photographs of patient C

before and after operation



A



B



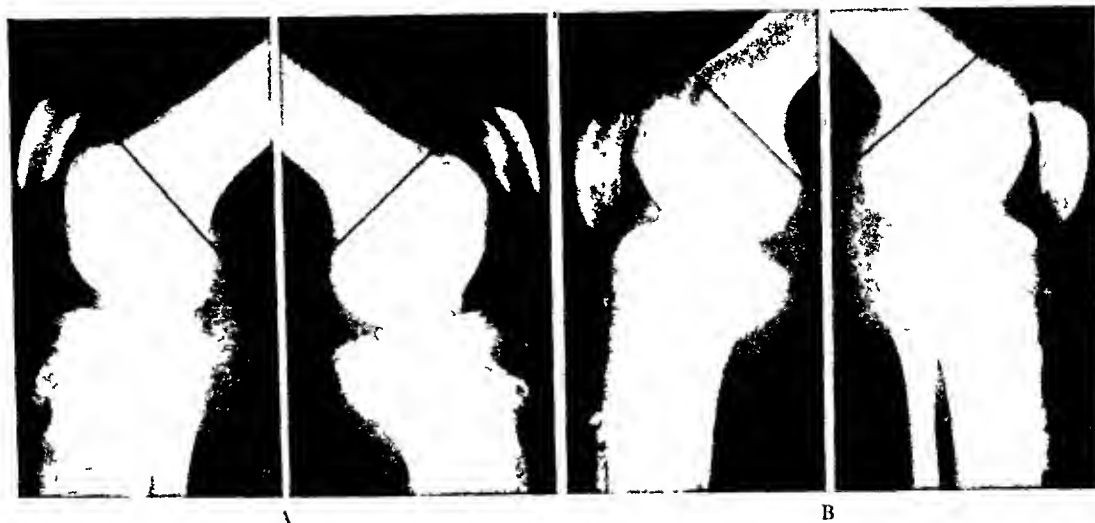


Fig 7 Case 3

1 inch distal to its normal site. The block was held in place with silk sutures and a 2 inch wire nail. Plaster of-paris spica bandages were applied. The nail was removed 2½ weeks after operation, and the plaster splints were removed 6 weeks after operation. It was noted that on discharge from the hospital 2½ months after operation his knees were straight, and he could flex them to 90 degrees.

At his latest follow up examination, 26 months after operation, it was noted that the patient could fully extend his knees. He flexed his knees slightly when walking and was still a marked spastic. The patella were level with the joint line. He could not walk alone before operation, and he now walks reasonably well.

In Figure 5, A and B, the patient is shown before operation while C and D show the patient 2 years later after operation. The absence of knee flexion is apparent.

The roentgenograms (Fig 6) of right and left knees before, A, and after, B, operation show the striking shift distally of the patella in relation to the femoral epiphyseal lines. The pre-operative roentgenograms were taken with braces on, which somewhat obscure the bones.

**CASE 3** L DeM, St L No 111-282, a boy 17 years of age. The patient had always walked stiffly with his knees flexed. He had had the hamstring tendons lengthened without benefit. His knee jerks were extremely active, and he showed a bilateral ankle clonus. The knees were held in 20 degrees of flexion while the patient was completely at rest, recumbent. The patella lay about 1½ inches above the joint line. When standing, the knee flexion was markedly increased.

He entered St Luke's Hospital on July 9, 1935. A bilateral tibial tubercle transplant was performed. At this time the modified technique was first used. The tibial tubercles were anchored by driving an autogenous bone peg through the ligamentum patellae just proximal to the block of bone, and the periosteum of the transposed fragment was sutured to the adjacent periosteum with silk.

The wounds healed uneventfully, and the patient wore straight circular plaster-of-paris splints for 7 weeks, and then he wore braces until November 8, 1935, 17 weeks after operation. Ten months after operation, his knees showed full active extension and no flexion contracture. His walking and his stance were greatly improved.

Roentgenograms (Fig 7) before operation, A, and after operation, B, show the distal shift of the right and left patella incident to the transplant of tibial tubercles. The roentgenograms which were taken after operation were performed show the actual distance which the tubercles were transplanted and also the autogenous bone pegs *in situ*.

**CASE 4** V B, St V Hosp, a boy 15 years of age. A few days after birth it was noticed that the patient had nystagmus, a cephalic cry, and spasticity of the legs and arms. As he grew older, he had marked deformity of both legs, especially the left, making it very difficult to move about. He became exhausted after walking a few minutes and was compelled to sit down and rest before resuming locomotion again. His mentality was not impaired—there is no history of any hereditary or neurological disease in the family.

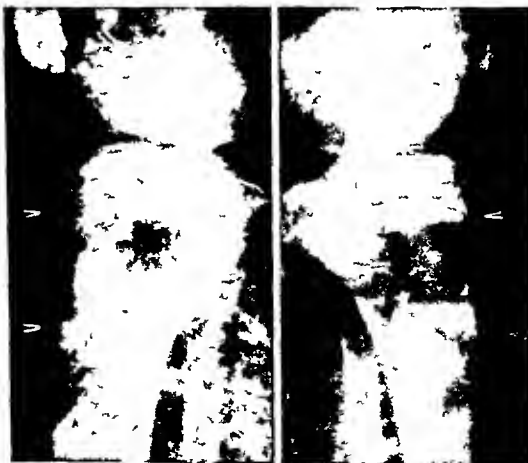


Fig 8 Case 4

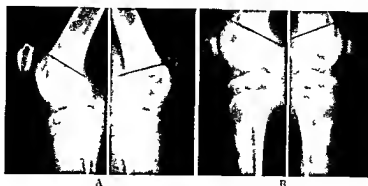


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# PERFORMANCE

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## FEMORAL HERNIA

A R DICKSON, M D , F A C S , BATTLE CREEK, MICHIGAN

THE operations for repair of femoral hernia are innumerable. Technique in this country has in the main crystallized into two types with slight variations: that of the femoral approach or the Bassini operation, and the inguinal approach following the technique of Moschcowitz (4, 5). The technique of Lotheissen (2, 3), sound as it is in principle, has not been widely adopted. The majority of writers on the subject consider femoral hernia a simple surgical problem with the operative repair completely and satisfactorily worked out by either of these standardized procedures and with the recurrence rate very low. A smaller group believe that the recurrence rate in femoral hernia is higher than statistical studies indicate because of the difficulty in tracing cases after operation, and that present operations in common use throughout this country are not anatomically sound and violate good surgical principles. Dowden states "Almost every surgeon will agree that the radical operation for the so called cure of femoral hernia is unsatisfactory. Recurrence is humiliating and not at all uncommon." Recurrences have been stated by various authors at rates of from 4 to 30 per cent. Extremely low figures are probably incorrect because of the difficulty of following cases after operation.

This paper attempts to emphasize some of the important principles stated by previous writers and to apply these to a practical and successful operative technique.

Of first importance is the principle that any form of hernial closure that ignores the fascial structures of the abdominal wall is unsound. This holds true of any hernia whether it is epigastric, umbilical, postoperative, inguinal, or femoral. The endo-abdominal fascia is essential to the integrity of the abdominal wall, and any breach in the wall must first pass this fascia before becoming a hernia. An indirect inguinal hernia does not become such, no matter how long a preformed sac has remained dormant, until the internal ring, which is an opening through the transversalis or endo-abdominal fascia, becomes dilated. A direct inguinal hernia is a relaxation of this fascia. In a femoral hernia the transversalis fascia and iliac fascia are separated, and the fascial layer connecting them at the inner end of the femoral canal, or crural septum, is pushed ahead of the advancing sac. The overlying muscles are of great im-

portance, but any repair that is chiefly concerned with muscular structures, or structures at a distance from the abdominal cavity, is unsound.

Another fact is frequently ignored. The femoral ring has rigid, inelastic walls. Poupart's ligament cannot be so securely sutured to either the pectineal fascia, or Cooper's ligament, that it will not frequently pull off and reopen the femoral canal. This ligament is stretched like a string across a bow, with heavy abdominal muscles attached to its upper surface which tend constantly to restore it to its normal position. The futility of such procedures is demonstrated in the many early operations in which silver wire, staples, bone pegs, etc., were resorted to in attempts to fasten down permanently the inguinal ligament to the underlying structures. The problem must be attacked in a different way. Normally there is no femoral canal, the femoral vein lying in close proximity in Gimbernat's ligament. This space is opened up by an advancing hernia, pushing the femoral vein laterally. When the hernia is properly repaired it cannot enter this artificial canal and the femoral vein again fills up the space.

A strong objection to operations attacking the femoral canal, especially by the crural approach, is that they close the lower end of a funnel leaving the funnel in place. This permits the force of intra-abdominal pressure again to exert its expanding pressure, and with the aid of muscular traction on Poupart's ligament, has a constant tendency to reopen the canal. A proper closure, as in all other hernias, should be flush with the abdominal cavity in order to diffuse this pressure. A relatively weak closure at this point is more successful than a strong closure at a distance. This point cannot be too strongly emphasized.

As anatomical facts have been better understood, operations for femoral hernia have been progressing upward. The crural approach has been decreasing in popularity and the inguinal operation more universally adopted. Closure of the femoral canal from above permits a higher ligation of the sac, but if this alone is done the repair is far from ideal. The primary defect in the endo-abdominal fascia is ignored, and all attention directed to the femoral canal as it passes beneath Poupart's ligament. As a consequence the fundamental weakness still persists and is the cause of recurrence of the femoral hernia, or it possibly shows up as a direct inguinal hernia. This

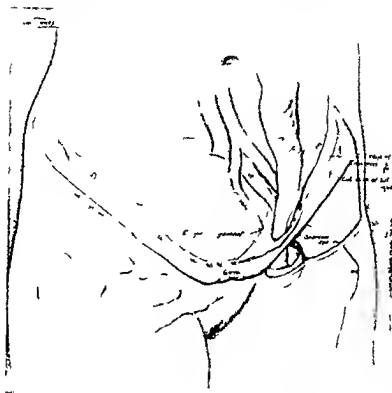


Fig. D. Section of female pelvis with structure forming the femoral canal. The pelvis tilted slightly forward is held slightly forward (Cut by S. L. G. D. H. L.).

defect if searched for can be easily demonstrated the gap through this fascia into the abdominal cavity often admitting three fingers. The purpose of this paper is to emphasize the importance of this gap in the endo-abdominal fascia and to carry the operation a step farther upward to repair this defect.

Of all the operations previously proposed for the closure of femoral hernia the Lotheissen technique comes the nearest to fulfilling the requirements of the anatomical and surgical principles involved. He recognized the importance of closing this breach in the endo-abdominal or transversalis fascia and accomplished this by suturing the entire conjoined tendon to Cooper's ligament. The chief objection to this method is the constant muscular pull on the suture line which may jeopardize its success.

The operation herein proposed is a modification of the Lotheissen technique. Instead of using the entire conjoined tendon it uses only the transversalis fascia. The transversalis fascia is the

inguinal portion of the endo-abdominal fascia which supports the entire abdominal cavity. It is a strong fascial layer lying superficial to the peritoneum and separated from it by loose areolar tissue. It is the fascial component of the conjoined tendon lying deep to the internal oblique muscle. It forms the floor of the inguinal canal and passes on to the thigh beneath Poupert's ligament to which it is attached. It there merges into the fascia lata. The transversalis fascia is the natural structure to use in the repair of a hernia for it is the loss of integrity of this structure that permits the egress of a hernia from the abdominal cavity. If this fascia is properly exposed it will be found to be a strong structure easily mobilized and readily sutured to Cooper's ligament. If it unites properly there is interposed between the abdominal cavity and the femoral canal a strong layer of fascia which successfully prevents the re-entrance of abdominal contents into this canal. It is not subject to the objections and defects that are inherent in a hernial repair in

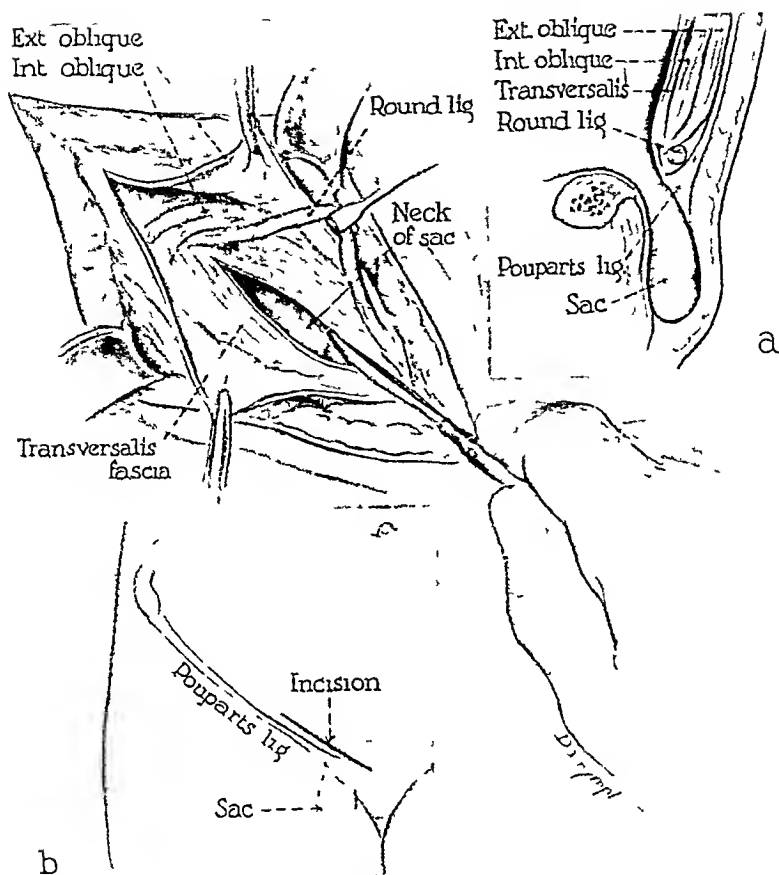


Fig 2 The external oblique fascia has been incised and retracted. Incision is being made in the attenuated transversalis fascia which forms the floor of the inguinal canal, exposing the neck of the sac. Insets show femoral hernia in cross section and position of incision.

which muscle is used. There is much better relaxation of the suture line during healing, which means a stronger and more solid union, also less muscular pull on the line of attachment to Cooper's ligament and less danger of attenuation. The treatment of the femoral canal is of minor importance and perhaps is best left unsutured.

The anatomy of femoral hernia will not be given in detail. An excellent description of Cooper's ligament is given by Seelig and Tuholske who also describe the inguinal operation of Moschcowitz. An illustration from the article of Seelig and Tuholske is reproduced as it gives a very clear view of the principal structures concerned in the repair of femoral hernia. Cooper's ligament is clearly shown overlying and covering the horizontal ramus of the pubis.

#### TECHNIQUE

The technique down to the removal of the sac is similar to either the Lotheissen or the Moschcowitz operation. The skin incision is made parallel to Poupart's ligament and about one-fourth inch above, the lower end being over the pubic bone.

The external oblique fascia is divided, thus opening up the inguinal canal. The cord or the round ligament is retracted upward and should be cleanly dissected from the canal. This can best be done by wiping, with gauze over the finger, beginning on the inner side of Poupart's ligament near the pubic bone and following down the fascia to the floor of the inguinal canal. None of the cord structures should be left attached to the fascial floor. A finger is passed around the cord

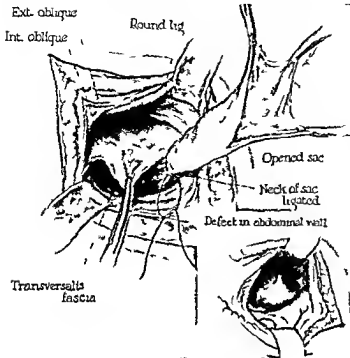


Fig 3

Fig 3 The sac has been divided and the neck ligated. The transversalis fascia has been divided and freed from the underlying peritoneum. The defect in the abdominal wall is shown. Inset shows the defect in the abdominal wall after removal of the sac.

Fig 4 The transverse abdominal muscle has been turned to Cooper's ligament. The femoral vessel is ligation to the testis. Inset shows the cross section.

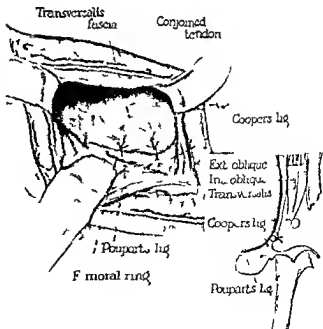


Fig 4

from behind and below, and it is then retracted upward, thus exposing the floor of the canal (Fig 1)

The floor of the canal is then incised parallel with Poupart's ligament, this incision being made through the transversalis fascia exposing the neck of the hernial sac (Fig 2) The neck is then separated from its attachments by passing a finger beneath it, the sac is entirely freed by blunt dissection and drawn up into the inguinal canal. If necessary the contents of the sac may first be reduced by an incision into the neck, and the contained omentum or loop of bowel withdrawn and inspected and then replaced in the abdominal cavity. The neck of the sac is crushed with forceps, ligated high with a suture ligature, and the sac is excised at as high a level as possible—an important point.

The defect into the abdominal cavity will be found upon examination. At this point the proposed technique diverges from that of Lotheissen. The transversalis fascia can easily be identified by retracting the internal oblique muscle upward (Fig 3), where it is seen as a strong sheet of white fascia applied to the inner surface of the internal oblique muscle and fascia. By placing forceps on its margin, it can be drawn down and mobilized sufficiently to be easily approximated to Cooper's ligament, where it is sutured usually with three interrupted chromic catgut sutures, the outermost suture being as near the femoral vein as is practicable (Fig 4). The objection has been raised that this leaves a defect so that a hernia can again pass between the outer margin of this fascia and the femoral vessels, but this is unlikely, as a hernia passing out with the femoral vessels is extremely rare.

The femoral canal can now be closed by suturing the posterior margin of Poupart's ligament to the pectineal fascia as in the Moschcowitz operation. It is possible to leave out this step entirely without jeopardizing the result.

It is well at this point to examine the internal inguinal ring and, if enlarged, to narrow it with one or two sutures. Otherwise no attempt is made to imbricate the inguinal canal. The cord is dropped back in place, and the external oblique is sutured. The superficial fascia and the skin may be closed in any manner desired (Fig 5).

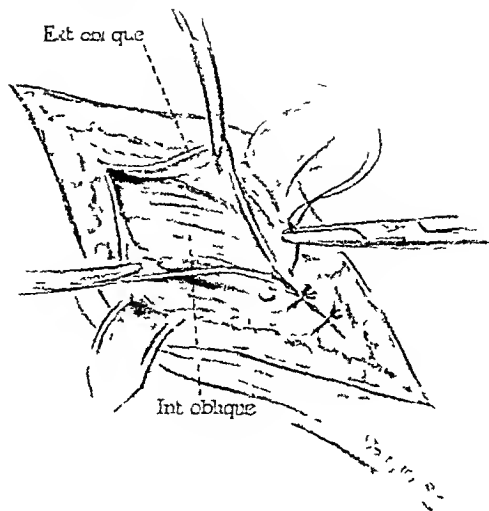


Fig 5 Superficial structures are sutured in their original position. Cord is not transplanted.

#### ADVANTAGES

One advantage of this plan of operation is that it repairs the defect at its source, using the normal anatomical structures through which the hernia first passes out of the abdominal cavity. The transversalis fascia can be easily mobilized and sutured without tension. This effectively blocks off the upper end of the femoral canal with a strong fascial structure which permanently prevents the re-entrance of a protrusion from the abdominal cavity. Thus the repair is entirely independent of the notorious uncertainty of permanently approximating Poupart's ligament to the pectineal fascia.

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## INTUSSUSCEPTION IN ADULTS

## TWO ADDITIONAL CASES

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SINCE the classical analysis of 300 cases of intussusception in adults by Eliot and Corcaden in 1911 numerous valuable contributions have been published. Good general discussions of the subject have been written by Hubner, Leclerc, Starlinger and others. Moore reported 2 cases of acute ileocolic intussusception in adults due to fasting. Moreton reported a case of intussusception in a 4 year old patient with typhoid and collected 10 other cases from the literature. Five of the 6 patients operated upon in Moreton's series recovered and 4 of the 5 not operated upon died. Meckel's diverticulum as a cause of intussusception in adults was reported by MacDonald (1 case) and Drummond (2 cases). Harkins analyzed 160 cases of intussusception of all ages due to Meckel's diverticulum. In Perrin and Lindsay's study of 400 cases of acute intussusception 18 patients were over 14 years of age. Intussusception into a gastro-enterostomy stoma has been reported by Lewisohn, Sibley, Darling, Schilling, Shearer and Pickford, Bettman and Baldwin and Adams. The roentgen ray diagnosis of intussusception is presented by Sussman and the treatment by transileal resection of the intussusception is discussed by Delore and de Girardier. Pryde and Moreton have reported cases in which there was recovery following spontaneous passage of the intussusception without operation. In 1921 Kingsford reported a case of intussusception in an adult in which the ileum was anastomosed to the transverse colon because the intussusception was irreducible. The entire necrotic intussusception was passed 10 days after the operation and the patient recovered. The value of short circuiting an irreducible intussusception by local anastomosis has been well established by Montgomery and Mussil who reported 2 successful cases in children and confirmation by experiments with dogs. Twenty five cases of intussusception in adults have been reported in which no tumor was found or at least described.

Eliot and Corcaden found that of 60 cases of intussusception in adults 100 (33 per cent) were due to a tumor. Of these tumors 60 per cent were benign and 40 per cent were malignant. They found that the benign tumors generally originated

in the inner layers of the intestinal wall and usually had constricted or pedunculated bases. Polyps occurred most frequently and were occasionally multiple. Other benign tumors described by Eliot and Corcaden were lipoma, myo-adenoma, fibroma, myxobroma, myofibroma, myxoma, papilloma and cyst of the ileocecal valve. In 1912 Kasemeyer analyzed 208 cases of intussusception due to tumor and found 55 to 75 per cent of the tumors were benign.

Since Eliot and Corcaden's paper there have been 43 case reports of intussusception in adults due to benign tumors. Nine of these were described as adenomas, 5 as polyps, 2 as papillomas. In addition to these 16 cases of epithelial type of benign tumor the case of Benjamin is of interest. In this case a male of 39 years there was an intussusception in the upper part of the jejunum beginning about 8 inches from the ligament of Treitz. A cauliflower like tumor 3 by 4 by 3 centimeters projected into the lumen of the bowel. It proved to be an adenoma of an accessory pancreas. Eleven cases of lipoma causing adult intussusception were found. Stettin found intussusception to have occurred in 60 per cent of 67 cases of intestinal lipomas. Nine cases of fibroma have been reported, 1 of which involved the appendix. Clifton and Landry collected 45 cases of fibroma of the intestine and found intussusception in 33 of them. There were two myxomas, a leiomyoma and a carcinoid. They reported an ileocecal enterocystoma (a type of mesenteric cyst) which produced a partial intussusception. In the interesting case of Steiger's there was an accessory pancreas in a diverticulum of the lower ileum which caused a subacute intussusception.

Since Eliot and Corcaden's paper there have been 16 cases of intussusception in adults due to malignant tumors. Of these 10 were carcinoma and 6 were sarcoma. Eliot and Corcaden in addition to carcinoma and sarcoma found a melanotic epithelioma.

Most of the cases of intussusception in adults are characterized by the symptoms of acute intestinal obstruction although there have been cases with previous attacks of obstruction which subsided without operation. Cases characterized by more or less chronic pain and vomiting and





Fig 1 Photograph of longitudinal section of specimen of jejunal intussusception  
Note papillary adenoma at the right Compare photograph with drawing (Fig 2)

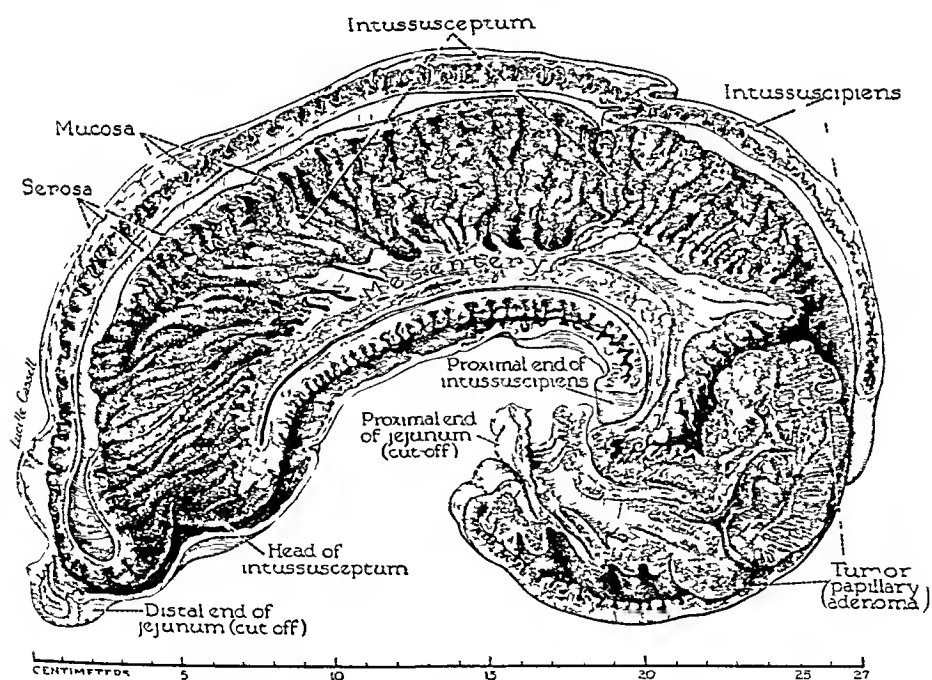


Fig 2 Drawing of specimen of jejunal intussusception Compare with Figure 1



# CHRISTOPHER INTUSSUSCEPTION IN ADULTS

normal and clean. The entire jejunum and ileum were carefully palpated but no tumors were discovered. In the cecum, however, a golf ball sized tumor was easily felt. Palpation of the colon indicated a small tumor in the right half of the transverse colon and numerous small tumors in the left half. Feeling that the patient might well have a multiple polyposis, and that it might be necessary ultimately to resect the entire colon, in ileocolostomy of the transverse colon was carried out and the right half of the colon together with the cecum and a few inches of the terminal ileum were resected at one stage. The pathologist (Dr F D Gunn) reported a pedunculated adenoma of the cecum. The suspected small tumor of the right half of the colon proved to be fecal material, a finding which threw considerable doubt upon the suspected presence of small tumors in the left half of the colon.

The patient made a satisfactory recovery from the second operation. Repeated examinations of the stools failed to disclose blood. On March 7, 1930, the hemoglobin was 85 per cent and the red blood count was 5,110,000. On March 22, 1930, the wound was practically healed and as the patient walked about easily he was discharged from the hospital.

A proctoscopic and sigmoidoscopic examination was done by Dr W Kenneth Jennings on March 31, 1936. The sigmoidoscope was passed for a distance of 22 centimeters. The rectum and sigmoid were entirely normal.

*Chronic ileo cecal intussusception*

CASE 2. *Chronic ileo cecal intussusception*. Patient K. P. U., female, aged 40 years, was admitted to the Evanston Hospital on March 19, 1931. For about a year the patient had noticed a mass in the right lower quadrant which was unproductive of symptoms until about 6 weeks previously when she began to experience vomiting, abdominal cramps, and malaise. Five days previous to admission the mass became painful and the cramp-like pains more severe. There had been no constipation, bloody stools or loss of weight. There had been a history of moderate cardiac decompensation. The patient is well nourished and the physical examination was essentially negative save for a large, elliptical, tender, movable mass in the right lower quadrant. Repeated examinations of the stools failed to reveal occult blood. Roentgen ray examination (Dr James T Case) revealed an organic lesion of the cecum which had "the ear marks of carcinoma." The blood Wassermann was negative.

On March 25, 1931, exploratory laparotomy was carried out under nitrous oxide gas and ether. A mass the size of a baseball was found, which involved the cecum and the adjacent ileum. It extended about 4 inches in each direction from the ileocecal valve. In the mesentery of the ileum and cecum in this region were numerous hard lymph nodes ranging from 2 centimeters in diameter near the bowel to smaller sizes as the mesentery was followed up toward the pancreas and duodenum. A diagnosis of carcinoma with metastases to the lymph nodes was made and a radical resection was carried out. The cecum, ascending colon, proximal half of the transverse colon, and 12 to 14 inches of the ileum were removed in one block. A lateral anastomosis between the ileum and transverse colon was then performed and the rent in the mesentery was sutured. Omentum was applied to the anastomosis and a Witzel enterostomy was done 7 inches proximal to the resection. The enterostomy tube was carried out through a stab wound in the right lower quadrant and the wound was closed without drainage.

The pathological report (Dr Francis D Gunn) of the excised specimen is as follows: "Gross (Fig 3). This specimen consists of about 40 centimeters of small intestine (lower segment of ileum), the cecum, ileocecal valve, and approximately 22 centimeters of ascending colon measured from the ileocecal valve. The wall of the lower 10 centimeters of the ileum is thickened and indurated. The distal 4 centimeters of the ileum protrudes into the lumen of the cecum. This portion will barely admit the tip of the small finger. This intussuscepted segment shows purplish discoloration, induration, and there is an excessive quantity of mucus in its lumen. The mucous membrane of the cecum shows a high grade of edema. The peritoneal surface in the region of the ileocecal valve is rough, granular, and spotted with purplish hemorrhages. The mesentery is thickened, edematous, hemorrhagic, and contains several enlarged soft hemorrhagic lymph nodes. Several soft lymph nodes with prominent follicles are included separately. A sheet of fibrous connective tissue with fat resembling omentum is included separately. Sections are taken from the ileocecal valve in the center of the indurated mass, from the wall of the cecum, and from the mesenteric lymph nodes.

*Microscopic*. Sections taken from different parts of the indurated mass at the ileocecal valve show evidence of chronic inflammation in the form of edema, numerous large foci of lymphocytic, plasma cells and eosinophil infiltration, interstitial hemorrhage, and proliferation of fibroblasts. This infiltrate involves the entire thickness of the muscular wall and extends out into the mesenteric fat. "There is no evidence of malignancy in the tissue examined.

Sections from the lymph nodes show high grade follicular hyperplasia, moderate reticulo endothelial hyperplasia, interstitial hemorrhage, and edema. The pulp shows further evidence of subacute and chronic inflammation in the form of plasma cell, eosinophil and neutrophilic infiltration into cecum, with chronic inflammation and edema of the regional lymph nodes."

The postoperative course was extremely stormy and the patient died despite all therapeutic efforts on the third postoperative day. At postmortem examination, although the anastomosis was found to be water tight an acute generalized fibrinopurulent peritonitis was present. This apparently was due to displacement of the enterostomy tube from the ileum permitting the escape of intestinal contents into the peritoneal cavity.

## SUMMARY

Two cases of intussusception in adults are reported. One case involved the high jejunum and was caused by a papillary adenoma, the other involved the ileocecal valve and showed no definite cause.

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## GENERALIZED PERITONITIS SECONDARY TO RUPTURE OF THE APPENDIX

WITH SPECIAL REFERENCE TO SERUM THERAPY

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**D**URING recent years interest in appendicitis has been renewed because of statistical reports which indicate an increasing mortality of this disease. Although reports of this type may be misleading, they nevertheless serve a useful purpose in emphasizing the importance of continuing efforts to reduce this excessive mortality. It is now estimated that approximately 20,000 to 25,000 people die each year in the United States of appendicitis. For the most part, these are young and otherwise healthy individuals.

Donaldson said that the death rate from appendicitis in 1928 was 5.6 per 100,000 population higher than it was in 1900. In contrast, Walker found a mortality of 7.8 per cent in a review of more than 16,000 cases of appendicitis collected from the literature during the years 1907 to 1910, and a mortality of 5.3 per cent in 33,000 cases collected during 1927 to 1930. This indicates that the mortality has been reduced although the total number of deaths has increased. Whether appendicitis has become more prevalent or whether it is recognized more frequently as the true cause of a fatal peritonitis is difficult to determine. The fact remains, however, that far too many people die each year of appendicitis.

The responsibility for reducing this mortality of a disease so readily cured before advanced complications develop lies entirely with the medical profession. People should be instructed concerning the possible seriousness of abdominal pain which persists for more than a few hours, and should be warned against the indiscriminate use of laxatives in the presence of abdominal pain. In this connection a law requiring that a warning be placed on all laxatives sold at drug stores, as has been suggested by C. W. Mayo and others, might be of value. That the use of a purge in appendicitis favors rupture and peritonitis has been repeatedly demonstrated. From the point of view of the physician, early diagnosis and early operation are imperative, and every effort should be made to avoid delay. In the initial 72 hours after the onset of the attack, the mortality almost

doubles during each 12 hour period that elapses between the onset of symptoms and operation (Keyes). Under ordinary circumstances it appears much safer routinely to remove a subacute appendix than to risk the chance of rupture while hoping that the process will subside under medical management. The risk of appendectomy before rupture has occurred is practically negligible. So called "interval appendectomies" prevent subsequent severe attacks and should be performed when feasible. This does not mean that the diagnosis of appendicitis should be made without care and consideration, but one definite attack of acute appendicitis should be a warning that recurrent attacks are prone to follow.

## PATHOLOGY

Although it is approximately 50 years since Fitz first described accurately the pathological changes which occur in acute appendicitis, many questions regarding the pathogenesis, bacteriology, diagnosis, and treatment of this disease remain unsettled. Clinically and pathologically, the significance of Wilkie's differentiation of the two important types of appendicitis has probably not been sufficiently appreciated. Wilkie emphasized the distinction between "acute appendicitis" and "acute appendicular obstruction." The former condition is primarily an inflammation of the wall of the appendix, without initial obstruction of the lumen. This type of appendicitis is usually gradual in onset, less rapid in its course, and less likely to progress to gangrene and rupture than is the obstructive type. In "acute obstructive appendicitis" a closed loop type of obstruction actually exists, and, consequently, the clinical picture is more suggestive of acute intestinal obstruction with bouts of colic-like abdominal pain. At the onset, systemic reaction is usually slight and the temperature and pulse may remain normal until the pathological process is far advanced. Gangrene of the appendix with perforation and peritonitis may occur very rapidly. Obstruction in the appendix may be

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caused by fecaliths foreign bodies links from fibrous bands adhesions and other less common abnormalities. This is the most dangerous form of appendicitis because of its rapid progress and serious sequelæ. It is largely among this group of cases and those in which a purge has been used following the onset of acute symptoms that deaths from appendicitis occur.

For the sake of clarity in any discussion of appendicitis an accurate definition of terms and grouping of cases are essential. In fact the lack of a clear understanding of the exact type of appendicitis under consideration accounts for much of the confusion that exists in the literature on this subject and adds to the difficulties of comparing mortality figures and consequently the efficacy of various types of treatment. The following types may be recognized (1) acute suppurative or gangrenous appendicitis without rupture (2) acute appendicitis with rupture and localized peritonitis (3) acute appendicitis with rupture and generalized peritonitis and (4) appendicitis with rupture and the formation of a localized abscess. It is true that each successive type may represent a later stage of the previous type so that a mixed clinical picture may result during the transition period from one type to the next. Under such circumstances it is often difficult to determine the exact extent of the pathologic changes present. It is important that the stage of the disease is recognized as accurately as possible because treatment will vary accordingly. In the present discussion only the cases which belong to group 3 namely cases of acute appendicitis with rupture and definite evidence of generalized peritonitis will be considered.

#### DIAGNOSIS

Clinically the most frequent diagnostic difficulty in these cases is the determination of whether the peritonitis is localized or generalized. As is well known the textbook picture of appendicitis which includes nausea vomiting abdominal tenderness and rigidity and leucocytosis is not always present before rupture occurs. This should emphasize the importance of early and accurate diagnosis before all the cardinal findings are present if the undesirable sequelæ of rupture are to be prevented. It seems superfluous to mention that the safest treatment of appendicitis with rupture would have been appendectomy before rupture occurred. In general the history elevation of temperature and pulse rate abdominal signs and laboratory studies will suggest the extent of peritoneal contamination. Diffuse abdominal tenderness and rigidity in contrast with

tenderness and rigidity localized in the lower right abdominal quadrant are very suggestive of an extensive peritonitis. Left sided peritoneal puncture as suggested by Arnheim and Neuhof might aid in ascertaining the extent of peritonitis as if pus is obtained by aspiration of the left side of the abdomen peritonitis must be generalized. We have not had any experience with this procedure. If the patient is operated on the diagnosis is usually strengthened by the appearance of the abdominal cavity and the type and amount of peritoneal exudate.

#### TREATMENT

Opinions vary regarding the proper management of appendicitis with rupture and generalized peritonitis (2 3 5 8 9 10 17). Some advocate immediate operation in all cases and others consider that medical treatment followed by operation is preferable under certain circumstances. It is extremely difficult to evaluate the relative merit of these two plans of procedure by review of the literature. Oftentimes different types of appendicitis are discussed certain cases of advanced peritonitis are excluded from the mortality figures and an accurate statement of the number of deaths that occur in the course of medical management in preparation for a deferred operation is seldom included. This long continued dispute is evidence of the fact that there are advantages and disadvantages associated with both types of treatment. It is beyond the scope of this paper to consider this phase of the subject in detail or to endeavor in any way to settle the problem. We will merely express our views on the matter.

Depending on the findings in the individual case the experience of the surgeon and the facilities he has available treatment may logically vary. In deciding between immediate and delayed operation it does seem obvious that one should consider the individual patient and not arbitrarily decide that if symptoms have been present for longer than 48 hours immediate surgical intervention is inadvisable. The great variation with which the pathological changes may progress in appendicitis has been repeatedly emphasized and we have all seen appendices that ruptured within 18 hours after the onset of symptoms and others which remained unruptured after 3 or 4 days. If operation is delayed the Ochsner type of treatment should be instituted. It is our practice to place the patient in Fowler's position to administer nothing by mouth to administer morphine regularly and to give fluids intravenously. No enemas are given.

TABLE I—MORTALITY OF ACUTE APPENDICITIS WITH AND WITHOUT RUPTURE (NO SERUM GIVEN)

Type of case	Cases	Deaths	Mortality per cent
Group 1 Acute, diffuse, purulent, and gargerosus appendicitis without rupture (Dixon)	437	0*	0
Group 2 Appendicitis with rupture and localized peritonitis	79	1	1.3
Group 3 † Appendicitis with rupture and generalized peritonitis	51	6	32.1
Group 4 Appendicitis with rupture and formation of a localized abscess	61	4	6.5

\*One patient died 12 days after operation, from exacerbation of a cerebral condition of long standing. The abdomen was clear.  
 †Includes all cases in which the diagnosis of appendicitis with rupture and generalized peritonitis was made, even if the patient was moribund at the time of admission. Eight of the patients who died were not operated on.

large, hot abdominal stipes are applied continuously, and continuous transnasal duodenal drainage is employed if vomiting or distention is marked. This type of treatment is carried out with the hope that the generalized peritonitis will resolve into a localized abscess which can subsequently be drained with a low risk to the patient. The patient is thus transformed from Group 3 to Group 4 as shown in Table I.

In general, we favor immediate operation in all cases of appendicitis before rupture has occurred and in certain cases after rupture has occurred. If doubt exists concerning the perforation, immediate operation appears advisable, because if rupture has not taken place peritonitis can then be prevented. If perforation has existed only a few hours, operation is usually performed unless extensive peritonitis seems to be present. Extreme care must be exercised under such circumstances to avoid spreading infection at the time of operation. If it appears that rupture has occurred a number of hours prior to the patient's admission to the hospital, we often consider immediate operation inadvisable. If the signs and symptoms indicate that infection has remained localized, it is evident that the natural defensive mechanisms have thus far prevented diffuse peritoneal involvement, and appropriate medical treatment should favor continued localization. When an abscess has become walled off, it can be drained extra-peritoneally, with little danger of disseminating infection. If the patient is first seen when generalized peritonitis obviously exists, medical management, as outlined previously, may be effective in localizing the process, whereas, immediate operation carries a very appreciable risk. Should conservative treatment be instituted for a localized peritonitis that becomes generalized in the course of this treatment, surgical intervention may be advisable.

If operation is performed and peritonitis is present, drainage (with soft rubber drains of the Penrose type, without gauze) should be instituted, and appendectomy may or may not be performed.

Removal of the appendix often appears desirable if it is readily accessible. If the cecum is markedly involved in the inflammatory process, the appendiceal stump usually is ligated, treated with carbolic acid and alcohol, but is not inverted. In contrast, if mobilization of the appendix necessitates trauma to the adjacent inflamed structures, it seems preferable not to disturb the appendix at this time but to postpone appendectomy for 2 or 3 months until the acute inflammatory process has entirely subsided. Subsequent appendectomy should not be deferred indefinitely, as repeated rupture may occur.

Many types of treatment, including lavage of the peritoneal cavity with alcohol, ether, water, or various antiseptic solutions, cecostomy, enterostomy, intra-abdominal injections of oxygen, ozone, or other agents, drainage of the thoracic duct, continuous abdominal lavage, and ultraviolet irradiation of the mesentery of the small intestine have been suggested for peritonitis. The value of most of these procedures remains doubtful.

*Serum therapy*—The bacteriological approach in the treatment of peritonitis has been extremely difficult because of the nature and large variety of bacteria involved. Unfortunately, these bacteria are not the organisms which form strong exotoxins. Routine bacteriological studies in cases of acute appendicitis usually reveal a mixed type of infection. Aerobic cultures most commonly reveal *Escherichia coli*, but also disclose streptococci, staphylococci, *Pseudomonas aeruginosa*, and other organisms. Anaerobic cultures frequently reveal *Clostridium welchii*, *Bacteroides ramosus*, *Vibrio septicus*, and other bacteria (11, 12). Wernberg (33, 35) studied 200 cases of acute appendicitis at the Pasteur Institute and found anaerobic organisms present in 30 per cent of these cases. These organisms were found much more frequently in cases of gangrenous appendicitis. This work has been confirmed in Germany, France, Japan, and this country (11, 12, 15, 20, 26, 28), and some workers have found anaerobic organisms in a much higher

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### WATER

THE position of that lowly but useful article of diet, water, has changed amazingly in the estimation of the guild of surgeons within the memory of many of us. It is not such a far cry to the day when acting upon what was supposed to be scientific evidence we systematically withheld water not only before operation, for periods running up to 12 or even 18 hours, but routinely after operation for one or even more days. That serious disaster did not regularly follow was perhaps due to the fact that less elaborate and trying surgery was undertaken. When disaster did in fact befall, it was charged off to the inevitable risk of the operation. In the intervening period, the work of fundamental and clinical scientists has shown that such rigor was not only unnecessary, but dangerous. Today, particularly our younger colleagues, talk light-heartedly, in the jargon of the trade, of dehydration, water balance, chloride deficiency, low serum protein, and many other abstractions which sound learned, and are so

in fact, if they by chance know how to fit the phrase to the situation. There is, however, a good deal of evidence tending to show that these phrases do not always represent scientific understanding and that attempts to apply them as therapeutic measures are not always to the advantage of the patient. For instance, we hear much of dehydration, but commonly enough in patients in regard to whom there is testimony, but no evidence of the fact. Recent contributions to the literature at least suggest that there is a fashion in the treatment of this condition not unlike that in ladies' hats, which is not only seasonal, but sectional in its distribution.

We are amply supplied with scientific information proving beyond peradventure that the surgical patient must be kept in balance. Thus he must be kept in water balance, in electrolyte balance, and if possible in protein balance. That, in spite of the various satisfactory methods by which water can be administered other than by mouth, these balances are not always maintained is to say the least tolerably obvious. For instance, it is not uncommon to see a situation in which it is apparently assumed that if a sufficient amount of fluid is administered to provide the kidney with an adequate water supply (1000 to 1500 c. cm.), balance will thus be attained. Sight is often lost of the fact that insensible—sometimes called nonsensical—water loss by skin and lung normally amounts to 1000 to 1500 cubic centimeters. Furthermore, sufficient attention is not always paid to water loss of other types, such as vomiting, diarrhea, and excessive sweating. We have overlooked oftentimes the fact that the water loss sustained

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during surgical operations is not inconsiderable. Coller and Maddock have clearly shown that the average water loss in any considerable operation is about 1000 cubic centimeters. Too often also we overlook the actual loss of blood and unless one is faced by the actual evidence it is common to assume that very little blood is spilled when as a matter of fact 1000 or even 1500 cubic centimeters may have gone to the wash. Roughly and generally speaking the daily normal water loss is 800 to 3000 cubic centimeters of urine, 200 cubic centimeters in stool and 1000 to 1500 cubic centimeters of insensible loss. To this must be added the abnormal items above enumerated. Coller and Maddock estimate that the average patient should receive at least 2500 cubic centimeters of water during the 24 hours following operation. Subsequent to that time he should receive in the neighborhood of 2000 cubic centimeters assuming that there is no abnormal water loss.

The maintenance of electrolyte balance requires chiefly the supply of sodium chloride to the amount of about 5 or 6 grams a day. Now in our attempts to maintain water balance it is not uncommon to see the routine intravenous administration of normal salt solution often in amounts up to 2000 or 3000 cubic centimeters a day and maintained over a considerable period. This obviously supplies the patient with an amount of sodium chloride enormously in excess of his requirement and if persisted in will successfully achieve the development of edema. In this dilemma recourse has been had to another isotonic solution, 5 per cent glucose, but since this is commonly administered in normal salt solution or in Ringer's solution the overload remains substantially the same. Such light hearted administration of fluids may be thought of as a savour of carelessness but it does in fact commonly occur. In the same connection we have

overlooked the fact familiar to all physiologists that water administered by mouth is a powerful diuretic whereas water administered subcutaneously or intravenously is not.

Since the days referred to in the opening paragraph when we were largely without methods of supplying water except by mouth the experts have again come to our assistance. They have shown us that the administration of water by rectum is an unsatisfactory method of supplying fluids. They have shown us that water in almost unbelievable quantities if given in isotonic solution, may be introduced into the body by the subcutaneous route quite without discomfort to the patient. One notes however, that the teachings of Woodruff that the use of multiple small caliber needles would successfully introduce large quantities of salt solution or 5 per cent glucose without discomfort to the patient have been largely overlooked. The surgeon still shies at subcutaneous administration because he associates it with puncture by large needles, distention of the tissues and pain. These are characteristic of faulty method and should not be charged against the subcutaneous route in maintaining water balance. The experts have shown us that the intravenous method using properly prepared solutions is extremely effective and relatively harmless. They have assured us that intravenous solutions introduced at a proper rate will not overburden even the damaged heart.

But there is still too wide a gap between the basic knowledge supplied us by the scientist in regard to maintaining the balances of the body and the wisdom with which this knowledge is put into practice. The burden of my song is a simple one. Our experts clinical and scientific have done their part. Our junior colleagues have the knowledge. It remains for those upon whose shoulders rests the supreme responsibility to see that this knowledge is

utilized. Such not uncommon happenings as the production of edema by the routine daily administration of 1000 to 2000 cubic centimeters of salt solution or the comfortable conviction that a patient is in water balance because we are supplying him 2000 cubic centimeters of water, whether subcutaneously or intravenously, while as a matter of fact, he is

losing 1500 to 2000 cubic centimeters by vomiting, 1500 cubic centimeters by sweating, and hopefully, 500 cubic centimeters in the urine, ought not to occur. I plead in short that in this dilemma utterly basic to the patient the surgeon shall clearly demonstrate in his planning that "there is some intellectual process involved."

HUGH CABOT.

# MEMOIRS

## LORD MOYNIHAN

**B**ERKELEY GEORGE ANDREW MOYNIHAN was born on the island of Malta October 2 1863 and died at his home in Leeds September 7 1936 He was the only son of Captain Andrew Moynihan of Irish stock who had gained the Victoria Cross in the Crimean War at the assault on the Redan At the time of his son's birth Captain Moynihan was of the 90th Regiment Afterward he was of the 8th Foot (The King's Regiment) and he served with distinction in the suppression of the Indian Mutiny

The forefathers of Berkeley Moynihan for several generations had held army commissions but he was not to follow in their footsteps He was educated at the Royal Naval School and received his medical training at the Leeds Medical School and the University of London He began the clinical part of his studies at the Leeds General Infirmary in 1886 He took his degree of M B B S at the University of London in 1887 with the diplomas of the Royal Colleges He took the F R C S in 1890 and in the examination for the degree of master of surgery in 1893 was awarded a gold medal In 1893 he married Isabella Wellesley Jessop daughter of T R Jessop F R C S J P of Leeds Moynihan owed much to his early association with Mr Jessop who preceded him as surgeon to the Leeds General Infirmary

Those who are interested in Moynihan's accomplishments his society memberships and the various honors which were conferred upon him I will refer to the *English Who's Who* which gives these data in detail My hope in reviewing the life of Moynihan is to show him in the picture of his time in England sketching briefly the achievements which made him outstanding not only in his profession but in the intellectual strength of Britain

It will be remembered that England was slow to accept that great work of Pasteur and Lister which carried scientific medicine farther forward in fifty years than it had advanced in all previous history When we think of English medicine we think of London of the hospitals that had their beginning in the fifteenth century and of the great men who achieved a place there and made English medicine the leading scientific medicine in the world One cannot do this without devoting some time to English provincial medicine and to the accomplishments of physicians and surgeons outside London some of whom in their later days



*Berkeley Mayhew*





the lessons he impressed upon a susceptible youth were quite unforgettable Mayo Robson must rank among the very greatest surgeons of all time. We who were his colleagues will forever cherish the memory of a surgeon of the very highest rank, who was supreme in technical skill, adventurous in search of truth, restless in eager desire to seek better and still better methods of relieving the sufferings of mankind, of infinite resource, tender, compassionate, merciful.

It was under these illustrious teachers that Moynihan was trained. McGill's early death was a great loss to Leeds and to the profession of Britain and the world. Perhaps the surgical work with which McGill's name is most closely associated is the operative treatment of prostatic hypertrophy. He was the first to establish in England the operation of suprapubic prostatectomy, a procedure which he generously acknowledged had been done almost simultaneously but a little earlier by Belfield of Chicago. Mayo Robson served the University of Leeds and the Leeds General Infirmary from 1882 to 1902, when he went to London, where he continued his work.

When I first visited England, nearly forty years ago, I went to Leeds to see Mayo Robson because of his contributions to surgery of the upper abdomen—his work on gall stone disease is still a classic—and it was then that I met Moynihan. I became very much interested in him, and we established a friendship which lasted for life. For more than thirty years I received a cable greeting from Moynihan on my birthday, sometimes when I myself had forgotten the occasion. The news of his death came as a shock and a grief.

Moynihan began his professional career at a period when leading surgeons viewed one another as rivals. It is to his everlasting credit that largely as the result of his unceasing efforts they came to consider themselves as fellow workers in a cause. Moynihan stood unflinchingly for honest medicine. He fought quacks and quackeries, and by his debates in the House of Lords relating to medical legislation he accomplished much to keep English medicine clean.

Moynihan was skilled in many fields of surgery, but particularly in that of abdominal surgery. His work on cancer of the stomach and on ulcer of the stomach and duodenum was outstanding. In 1905 he published his monumental book *Abdominal Operations*, which ran through four editions. This book, although it included only those operations which are common to the two sexes and excluded operations on the kidney and bladder and for hernia, was the most illuminating treatise of its time on abdominal surgery.

Moynihan's work was not easy. Brilliant, indefatigable, a facile writer, an orator of exceptional skill and fascination, he yet had to surmount barriers as every young man must do if he reaches the heights. At Leeds he upheld the traditions of Hey, Wheelhouse, Pringle, Treace, McGill and Mayo Robson, whom he replaced on the staff when Mayo Robson went to London, but he raised to a higher level still the standing of the school and hospital, and in the years of his



brilliant achievement made Leeds as never before a great medical center. In 1926 he retired from the professorship of clinical surgery of the University of Leeds and became emeritus professor, but as consulting surgeon to the Leeds General Infirmary he exerted his guiding and inspiring influence to the day of his death.

Moynihan was interested in the United States. He was one who contributed greatly to the establishment of the American College of Surgeons. He was a member of the Editorial Board of *SURGERY, GYNECOLOGY AND OBSTETRICS* where his advice and active participation will be greatly missed. In his many visits to this country, by reason of his scientific presentations in surgery, and at times in the many interesting phases of medicine of the days gone by, he became known and loved by all. He was the supreme speaker in medicine, not only because of his magnetic voice and personality, his polished and beautiful diction, but because of the substance of the ideas he presented. It was not merely knowledge, but knowledge inspired by the wisdom which makes use of knowledge, that made him one of the greatest teachers I have known.

In his later years, because of professional affiliations, Moynihan had occasion to spend much of his time in London. His association with the Royal College of Surgeons of England was very active. He served on the Council and for six consecutive years he was President of the College. He delivered the Arris and Gale Lectures, 1898-1900, was Hunterian professor, 1919-1920, Bradshaw lecturer in 1920, Hunterian orator in 1927. In addition he was Romanes lecturer, Oxford, 1932, Walker lecturer, St. Andrews, 1933, and Linacre lecturer, Cambridge, 1936. In spite of his engrossing occupations in London he maintained his home at his beautiful estate in the outskirts of Leeds.

England is stable, and her stability not only is inherent in the character of her people, among whom fanatics are rare, but it is increased by the custom of the English Government of taking into political and social orders the great men of the country in all walks of life. The men thus elevated are given power to use their abilities for the good of society, not by the votes of the uninformed, not by appeal to the emotions of the people, but because of their genuine worth. The superior position conferred is for life, as are appointments to the bench in England and to the Supreme Court in this country. No matter what the background of the man, if he has added greatly by his intelligence to the economic or social welfare of the people, he may be distinguished, and, if one may say so, may become a stockholder in the English hierarchy. He may become in succession a knight, a baronet, and a baron, as Moynihan so worthily became. As one reviews the life of Moynihan, one sees manifest in its entire course the qualities in the individual which collectively have made England great and stable.

Lord Moynihan, brilliant, versatile, sound, a great surgeon and teacher, will be profoundly missed.

WILLIAM J. MAYO



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## THE PATHOLOGICAL YARDSTICK

ITS ACCURACY AS AN INSTRUMENT FOR MEASURING ERRORS IN CLINICAL, ROENTGENOLOGICAL, AND SURGICAL DIAGNOSIS OF GASTRIC LESIONS

LEWIS GREGORY COLE, M D, NEW YORK, NEW YORK

EIGHT microscopic sections of organic gastric lesions, chosen from surgical and autopsy specimens were presented to some or all of the following pathologists (A most hearty co-operation of all the pathologists consulted has been one of the high lights in my professional experience Therefore, above all things I am anxious that this contribution should be presented in such a way that it will offend none of them )

Dr James Ewing, Memorial Hospital, New York  
Dr Fred W Stewart, Memorial Hospital, New York

Dr I Lacassagne, Cure Institute, Paris, France  
Dr Ivan Bertrand, Paris, France  
Dr Paul Klemperer, Mt Sinai Hospital, New York

Dr Paul W Aschner, Mt Sinai Hospital, New York

Dr E Thompson Bell, University of Minnesota, Minneapolis, Minnesota

Dr A C Broders, formerly of the Mayo Clinic, University of Virginia

Dr A P Stout, Columbia University Medical Center, New York

Dr A M Pappenheimer, Columbia University Medical Center, New York

Dr Nathan C Foot, Cornell University Medical Center, New York

Dr Louis H Jorstad, Barnard Free Skin and Cancer Hosp, St Louis, Missouri

Dr Frank W Konzelmann, Temple University, Philadelphia, Pennsylvania

Dr Harrison S Martland, Newark City Hospital, Newark, New Jersey

Dr John W Gray, Newark, New Jersey  
Dr J W McWhorter, French and Bellevue Hospitals, New York

Dr Charles F Geschickter, Baltimore, Maryland  
Dr P Masson, Montreal, Canada

Dr Louis C Simard, Montreal, Canada  
Dr L J Rhea, Montreal General Hospital, Montreal, Canada

Dr W L Robinson, Toronto General Hospital, Toronto, Canada

Dr T B Mallory, Boston City Hospital, Boston, Massachusetts

Dr Fred Parker, Boston City Hospital, Boston, Massachusetts

Each pathologist was asked to examine the identical sections, to answer the three following questions, and to allow their answers to be published

- 1 Is the lesion malignant? Yes or no
- 2 What is the type of lesion—carcinoma, sarcoma, etc ?
- 3 On what criteria did you base your opinion?
  - A Arrangement of cells
  - B Size and shape of cells
  - C Nuclear changes
  - D Changes in the chromosomes
  - E The manner in which the cells take the stain
  - F Invasion of adjacent structure
  - G, H, I Any other criteria

If a teacher, he was asked if he would pass a student who could not differentiate a carcinoma from a sarcoma

A definite diagnosis by any method even though it is occasionally wrong is more to be desired than an equivocal one. There are four distinct methods of diagnosis namely clinical roentgenological surgical exploration and pathological. The relative value of a diagnosis from the clinical roentgenological and surgical findings is a controversial subject. No method is infallible but a microscopic examination has settled the question of diagnosis in each case where it has been possible to obtain it. Thus pathology has become the yard stick used to measure all other diagnostic errors.

In the early days of gastro intestinal roentgenology when there was great skepticism as to the accuracy of the method any old yard stick would do to measure its failures. Of my first 5 consecutive cases of x ray diagnosis of gastric cancer 3 were shown to be wrong (see Fig 1) 1 as measured by the clinical yard stick and 2 by surgical exploration namely the surgical yardstick. This was most discouraging but even then I retorted that none of these cases had been disproved by microscopic examination namely the pathological yardstick on which we all depend. However Father Time wielded his carcinomatous reaper on all 3 of these cases thus changing my percentage of something over 60 per cent error to 100 per cent accuracy on my first 5 cases.

Brewer's report of 27 cases presented before the American Surgical Association (1) in which x ray errors were measured by the surgical yardstick did more to establish gastro intestinal roentgenology than any other work with which I have been associated. This series of cases of Brewer's and subsequent experience showed that the x ray diagnosis of gastric ulcer is as easy and accurate as the diagnosis of fracture and furthermore that gastric cancer can be differentiated from ulcer by x ray as readily as the red cards can be separated from the black in a playing deck. Try this for yourself (see Fig 2). In every playing deck there is a joker and advertising card. By this time you have probably found the x ray joker in Figure 2.

In most cases of cancer the microscopic criteria is so characteristic that the diagnosis

is readily made but there are also pathological jokers (see Fig 3).

The report of these early successes in the diagnosis of gastric cancer does not mean that I have not made mistakes both of omission and commission. The most common cause of the error of omission was the failure to include the fundus or fornix in the examination. Lack of the knowledge at the time the examination was made that a simple ulcer never involves a greater curvature caused me to misinterpret a case of ulcerating carcinoma as an indurating ulcer. The prevalent erroneous conception that rugæ radiating from a crater indicate a non malignant lesion caused my downfall in another case which was reported in our book *Radiological Exploration of the Mucosa of the Gastro Intestinal Tract* (4) and also in the *American Journal of Surgery* (3). Misinterpretation of lack of pliability of a localized area on the lesser curvature was perhaps the most justifiable mistake if one can speak of a mistake as justifiable. I considered it due to a scar from an ulcer whereas it was really early carcinomatous infiltration (4).

In 1912 I made a diagnosis of ulcer on the lesser curvature and the patient subsequently died of carcinoma. Apparently the carcinoma developed at a different region but this could not be definitely established.

The most serious mistake that I have made at least in recent years was in a patient who was not only a patient but a friend. Mr D B 60 years plus suffered from symptoms rather significant of gastric ulcer. When I first saw him professionally he was scheduled to have a gastro enterostomy the next day for a gastric ulcer in the pyloric canal. I then considered that the ulcer was probably non malignant and recommended at least further rest in bed to allow for subsequent series of films. This second series and also others over a period of 3 years speak for themselves especially with the legends (Fig 4 A B C D).

As I now review these series of films and especially as I compare them with a case to be reported hereafter (Case I) I marvel at the queer quirks of man's mentality and philosophize on why on almost identical findings one sometimes makes a definite diagnosis of carcinoma as I did in Case I whereas in this

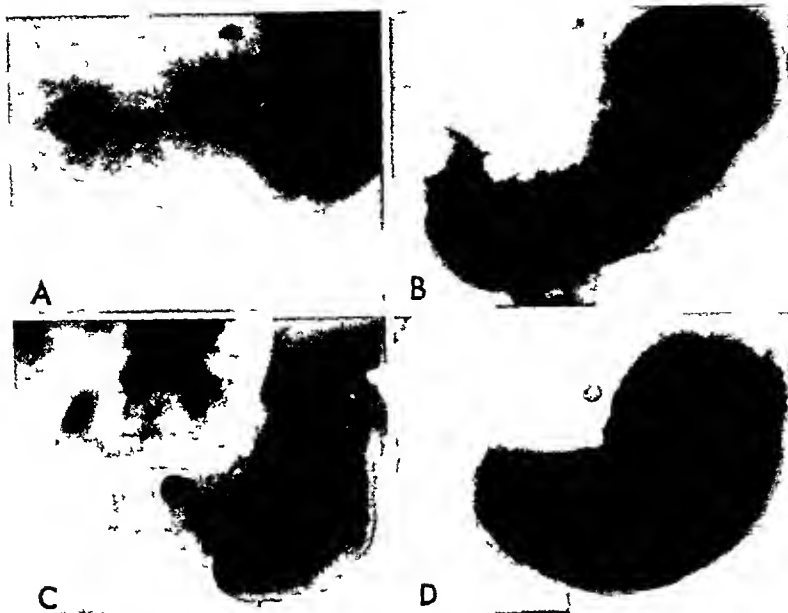


Fig 1 A, B, C, and D illustrate 4 of the first 5 cases in which I made a positive diagnosis of gastric cancer. A, A positive roentgenological diagnosis of carcinoma was proved correct by the yardstick of surgical exploration. The patient died within a week. Considering that this patient was so free from symptoms that she was bored at having to have the examination, I have often wondered whether I did a good or bad job in diagnosing this first case of cancer. B, A positive roentgenological diagnosis of a pyloric cancer was shown to be wrong by the *clinical yardstick*. The patient improved and was practically free from symptoms 9 months after the examination. C, A positive roentgenological diagnosis of a large pyloric cancer was shown to be wrong by the yardstick of *surgical exploration* and a gastro enterostomy. Mayo found two ulcers with glandular involvement and nodules in the liver but reported that "malignancy was not established" and therefore our roentgenological diagnosis was wrong. D, A positive roentgenological diagnosis of a small operable cancer. Surgical exploration proved that the clinical diagnosis of a small benign lesion was correct and the patient improved after a gastro enterostomy. Therefore the roentgenological diagnosis of cancer was again wrong.

Thus, as measured by the clinical and surgical yardsticks something over 60 per cent of our first 5 cases were wrong, but they all died of carcinoma thereby making our first 5 cases 100 per cent correct instead of 60 per cent in error.

case I was either equivocal or in favor of non-malignancy. In this case the fact that the patient was a friend as well as a patient led to the wish being father to the thought. Another reason was that very shortly prior to this I saved a friend of mine who was a doctor from losing the pyloric end of his stomach because it was considered malignant. And the third reason, which I must perhaps shamefully confess, is that I had been recently irritated by the statement that all ulcerative lesions in this region should be considered malignant and therefore rather bent over backward in the opposite direction, in this case.

The points to be learned from this failure are either not to treat your friends or else to treat them as patients rather than friends, to stick more strictly to the rules that you have laid down concerning the diminution and disappearance of the crater in a certain period of time, namely a month, and the third and most important is that while the roentgenological examination may be used to determine whether a lesion is operable or inoperable, that factor should be entirely divorced from the diagnosis.

I believe that I should have made a positive diagnosis of carcinoma at least at the time of



Fig 2



Fig 3

I Athro ghll oe tg o  
 g m f 8 g trcl llbt  
 fth md gl plt ad  
 gl se ee m t fth mha be  
 md d f th battle fth Mss-  
 pp Med l Associat an o  
 If t d c t d th d t d  
 tect fgt t t all s  
 tg gaphy d h t  
 t ted by p t t f l  
 lg p p i get th ty that  
 tg lgyw llrghf bo  
 kud eys d p h p l gs b t th  
 hadp d t t be g d lo g tro-  
 t tual les s Look t th po

Fig

the second examination and that I should not have confused the issue of a definite diagnosis of cancer with the decision of whether to operate or not to operate because of an adverse constitutional condition of the patient. In this case the clinical condition of the patient seemed to contra-indicate so radical an operation as a gastric resection, but this was not the fact because Dr. Fred Rankin of Lexington, Kentucky, successfully performed a gastric resection which prevented the patient from succumbing to carcinoma before he died of a cerebral hemorrhage about a year and a half later. This error is bad enough but in part it is redeemed by the fact that of his 5 year span  $3\frac{1}{2}$  years of this extension of life was due to our error and  $1\frac{1}{2}$  years' extension of life due to Dr. Rankin's successful operation which carried the patient through to a period where he succumbed to a lesion which is considered one of the natural causes of death aging arteries.

However, this article is an excellent opportunity of confessing one of my most serious errors and I now appreciate the relief afforded by a confession.

While attempting to correlate the roentgenological findings with gross pathology in order to establish the principles on which roentgenological diagnosis is based, gross surgical and anatomical specimens or microscopic sections or both were obtained in 87 consecutive cases. Large microscopic sections from these gross specimens were stained with various stains, except in 2 cases, in which I could not obtain the gross sections and had to be content with routinely cut and stained sections.

The microscopic criteria in some of these sections led me, an inexperienced observer, to

deductions of the identical roentgenograms in Fig. 2 A through H and see that you can now make a diagnosis of a gastric lesion and separate the cancers from the ulcers as readily as you can separate the red cards from the black in a playing deck. Yet, at that time and in fact long after that, roentgenography was considered worthless as a means to gastro-intestinal diagnosis. Every new pack has a joker, look out for the x ray joker!

Fig. 3. Microscopic findings are so classical that in the majority of cases of gastric cancer the pathological diagnosis is easy and accurate, but there are also pathological jokers. It is easier for you to make a definite diagnosis on the roentgenograms in Figure 2 than on the photomicrographs in Figure 3.

doubt the accuracy of the first or primary pathological report. Therefore, because of this doubt, or because the original pathological report was at variance with the roentgenological diagnosis, some of these sections were presented to other pathologists and the variation in the reports submitted by them led to the investigation herein reported.

Eight microscopic sections were selected out of 69 consecutive surgical and autopsy specimens. I fully realize that 8 microscopic sections are not sufficient to settle the problem under consideration, but I doubt if one could get this number of representative pathologists to study a large number of sections, and I doubt if you would wade through this material if it were more extensive than that which is being presented to you.

An incomprehensible diversion of pathological opinion was encountered.

Pathologists who saw these sections and particularly internists and surgeons who have discussed this subject continually refer to these 8 sections as rare specimens selected from hundreds of cases during a long period of time. They often intimate, but rarely say, that these sections have been collected by a destructive critic. This erroneous conclusion concerning these being highly selected sections has become so prevalent that to dispel it I am giving the number, initial, and date of all of these sections in tabulated form.

The 8 microscopic sections were selected from specimens obtained between October, 1927, and October, 1932, and, as you will see, there are only 51 gastric lesions from which these 8 sections have been selected, so you can readily recognize that these are not highly selected microscopic sections. A re-examination of the sections made between those dates and other microscopic sections included in Table I collected after October, 1932, or with an earlier date reveals that there are many more controversial cases in this complete list of 87 cases. The clinical, roentgenological or surgical diagnosis is not available on some of these additional sections and the additional sections were not presented to the group of pathologists, but from my observations I believe some of them would be even more controversial than some of those presented to





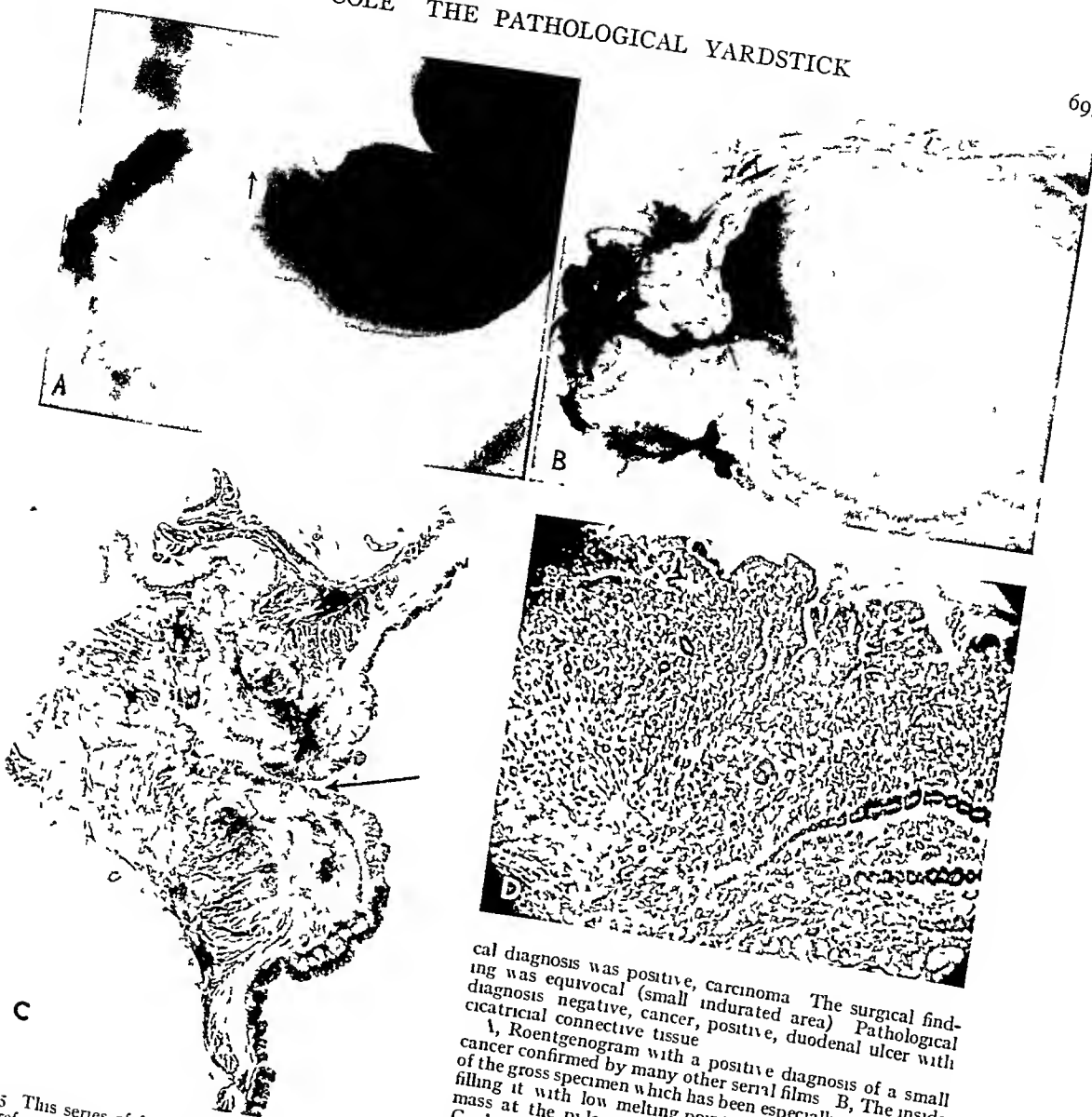


Fig 5 This series of four figures A B, C, D (Case I, Dr S, referred by Dr Lvan Evans, operated by Dr John Erdmann) shows the correlation of the roentgenological, surgical, and microscopic findings. The clinical history was suggestive of gall bladder disease. The roentgenologi-

CASE I The patient Dr S, was referred to me by Dr Lvan Evans with the request that I make an X-ray examination give the diagnosis directly to the patient and advise him whether he should be treated medically or surgically. This unusual procedure shifted onto my shoulders a great responsi-

cal diagnosis was positive, carcinoma. The surgical finding was equivocal (small indurated area). Pathological diagnosis negative, cancer, positive, duodenal ulcer with cicatricial connective tissue. A, Roentgenogram with a positive diagnosis of a small cancer confirmed by many other serial films. B, The inside of the gross specimen which has been especially prepared by filling it with low melting point paraffin. (Compare the mass at the pylorus with the roentgenological findings). C, A magnified photograph of the microscopic section. This should be compared with both the gross specimen and the roentgenogram. The arrow in each indicates the region from which the medium power photomicrograph was made. The irregularity at this point is shown in the roentgenogram, the gross specimen, and the microscopic section. D, Photomicrograph of the diseased mucosa in the center of the lesion at the point indicated by the arrow.

bility, and therefore I was perhaps flattered and unduly cautious at the time of the first examination on which I made a positive diagnosis of an organic lesion involving the pyloric end of the stomach, instead of carcinoma, and advised waiting 3 weeks, having an X-ray examination made each week to



Fig 6 Ca II Mrs. M. W. Th. Unusual history of the disease of gastric ulcer. X-ray diagnosis a large ulcer probably malignant. The gastric folds were enlarged with distortion. Pathological diagnosis sarcoma.

A Roentgenogram showing a large ulcer surrounded by a narrow zone of contraction. The text is partially obscured by the image.

th. Sophia's history. The point of proximal dilatation indicated by a star. Also the gastric folds. The roentgen diagnosis was gastric cancer. The histological diagnosis was gastric cancer. The microscopic examination of the ulcer showed the presence of malignant cells. The histological diagnosis was gastric cancer.

determine whether the lesion was progressing or regressing. At the end of the second examination on 21 weeks after the first (Fig. 5A) the lesion had not diminished in size but apparently it had not increased. But the findings were a little more clear cut and led me to advise immediate pylorotomy for gastric cancer. The patient consulted Dr. Erdmann who on his own clinical history made a positive diagnosis of gall bladder disease. The clinical history as obtained by both of us was at once suggestive of gall bladder disease certainly there was nothing in it to justify a clinical diagnosis of gastric cancer.

On the roentgenological evidence Erdmann hesitated to advise the removal of the pylorus but the patient wanted it and I shared the responsibility and a few days later Erdmann did a pylorotomy. The specimen was specially prepared by filling it with wax to prevent distortion during fixation and a photograph was made of the inside of the gastric specimen showing the lesion as it involved both the greater and lesser curvatures (Fig. 5B). A complete section along the entire greater curvature including the tumor mass observed in this photograph as sent to the pathologist at the hospital in which the operation was performed but the pathologist did

not see the entire gastric specimen. Neither did he know of the roentgenological diagnosis. The x-ray and clinical and surgical diagnoses. The routine pathological report was negative for gastric cancer and a positive diagnosis of gastric cancer. The tissue in contact to a healed duodenal ulcer was made. Again the roentgenological diagnosis was proved wrong this time by the final histological examination. The histological diagnosis was based on the study of an adequate section extending through the entire length of the lesion and including normal tissue both proximal and distal. This negative diagnosis of cancer based on a microscopic examination certainly was a shock to me outside of the responsibility which I had assumed in advising the pylorotomy. If I had first consulted Fappan or Konzmann, Martland, McWhirter and another pathologist who saw this specimen and made the final diagnosis of cancer, this would have been a different story. The pathologist had the pyloric end of the stomach resected almost solely on the roentgenological diagnosis.

However having learned not to be content with one pathological report or even several when they are at variance with the clinical roentgenological

or surgical findings, I first submitted my section (see Fig 5C) to Drs Ewing, Stewart, and Stout. This section had been taken from the tissue adjacent to that examined by the first pathologist. A pathological report of gastric cancer was given by them on this section and the attending pathologist at the institution where the operation had been performed concurred with them when he examined my section but contended that there were no evidences of cancer in that microscopic section which had been examined at the hospital, in incident which he said frequently occurred, namely, carcinoma being observed in one region and not in another. Then he reviewed his section which was observed to be identical even to including the same groups of cells and he reversed the previous diagnosis which his association had made of healed duodenal ulcer with cicatrization of connective tissue and gave a *positive diagnosis of gastric carcinoma*.

Both the original microscopic section and my own section were subsequently submitted to 19 pathologists who gave the following reports

NON MALIGNANT	
Original pathologist chronic duodenal ulcer	Parker carcinoma—colloid
Pappenheimer, ulcer phagocytic cells	Stewart carcinoma—signet ring
Konzelmann chronic inflammation	Klemperer carcinoma—scirrhous with mucus
Martland, chronic ulcer	Robinson carcinoma—scirrhous
McWhorter inflammatory lesion	Pritchard carcinoma—scirrhous
MALIGNANT	
Ewing carcinoma	Foot adenocarcinoma—colloid type
Second pathologist carcinoma	Gray adenocarcinoma—mucoid
Stout carcinoma—undifferentiated colloid	Geschickter linitis plastica signet ring
Rhea carcinoma—diffuse cell type	Masson linitis plastica
Malory carcinoma—colloid	Siward carcinoma—linitis plastica

ORIGINAL PATHOLOGIST  
 cer Old cicatricial connective tissue infiltrating Brunner's glands. No evidence of cancer.  
 PAPPENHEIMER *Non malignant*—I do not believe it to be carcinoma. *Criteria*—(A) Appearance is unusual because of the presence of numerous mucin containing cells in the stroma. These I regard as phagocytic cells rather than carcinoma cells. (B) Cells do not appear to invade the deeper tissues.  
 KONZELMANN *Non malignant*—chronic inflammatory lesion.  
*Criteria*—Not given.  
 MARTLAND *Non malignant*—chronic ulcer. No cancer.  
 McWHORTER *Non malignant*—Probably inflammatory lesion.  
*Criteria*—See no evidence of tumor growth.

MALIGNANT  
 EWING *Malignant*—carcinoma. Did not specify type of carcinoma or actual criteria on which he based diagnosis.  
 SECOND PATHOLOGIST *Malignant*—carcinoma.  
 STOUT *Malignant*—carcinoma undifferentiated colloid type. *Criteria*—(A) Infiltrative growth of "signet ring" cells (B) other atypical isolated hyperchromatic tumor like cells.  
 RHEA *Malignant*—carcinoma diffuse cell type. *Criteria*—Mucus? Suggest mucicarmine stain.  
 MALORY *Malignant*—colloid carcinoma very scirrhous in places. *Criteria*—Not given.  
 PARKER *Malignant*—colloid carcinoma very scirrhous in places. *Criteria*—Not given.  
 STEWART *Malignant*—carcinoma—signet ring type. *Criteria*—Not given.

KLEMPERER *Malignant*—scirrhous with mucus. *Criteria*—Notes mislaid.  
 ROBINSON *Malignant*—scirrhous carcinoma. *Criteria*—Loss of glandular elements and replacement by sheets of large cells which vary in size and shape and staining characteristics. Some have large hyperchromatic nuclei others pale vesicular ones. These cells with some modifications are infiltrating the muscle coat.

PRITCHARD *Malignant*—scirrhous carcinoma. Marked thickening of deeper layers of mucosa muscularis mucosa submucosa and muscularis. Great thickening of submucosa. *Criteria*—There is a diffuse lymphocytic infiltration with few nodules. Scattered throughout are small polyhedral cells with hyperchromatic nuclei. No extra gastric lymph nodes in section. These cells I consider epithelial. They appear to originate in the tip of the glands. *Foot* *Malignant*—adenocarcinoma of colloid or mucus producing type. Brunner gland region suggested. *Criteria*—(A) Anaplastic cells arranged in acinoid fashion or discreetly. (B) Mitotic figures present. (C) "signet ring" cells. (D) Mucicarmine stain of the wall.

GRAY *Malignant*—mucoid adenocarcinoma. *Criteria*—(A) Diffuse anaplastic growth of mucus producing glands involving mucosa and submucosa. (B) Pleomorphic cells the nuclei and nucleoli are hyperchromatic and mitotic forms are present. (C) In some areas the nuclei are quite widely separated by mucoid substances.  
 GESCHICKTER *Malignant*—linitis plastica signet ring' cells. *Criteria*—Not given.  
 MASSON *Malignant*—linitis plastica. *Criteria*—Cancerous mucous cells throughout hyperproduction of sclerosin.  
 SIWARD *Malignant*—atypical epithelium form linitis plastica carcinoma diffuse form. *Criteria*—(A) Oil immersion cells with light protoplasm vacuolar nucleus pushed aside—mucus? (B) diffuse infiltration of cells into submucosa the muscular layers the peritoneum. (C) desire mucicarmine for mucus. Fixation poor.

The x-ray diagnosis of gastric carcinoma and clinical diagnosis of gall-bladder disease were both proved wrong by the *primary* pathological report of simple duodenal ulcer, *no cancer*. Such a primary pathological report would be used for surgical statistics, business arrangements, life insurance, etc. Father Time took the patient in 14 months with his carcinomatous reaper.

The preponderance of pathological opinion is three to one in favor of malignancy but as we shall see in subsequent cases the preponderance of opinion is not always in accord with the dictum of Father Time.

CASE II Mrs M W, referred by Dr Blank, operated upon by Dr Blank, was admitted to French Hospital on March 6, 1924, with clinical diagnosis of ulcer, roentgen films made elsewhere showed a small ulcer on the lesser curvature. This ulcer was removed by resection but the symptoms persisted—in fact were aggravated. About 1 month later we made an x-ray examination (Fig 6A) and reported as follows "I believe we are justified in making a positive diagnosis of a large indurated area on the lesser curvature with an ulcerated center. This may be a large simple ulcer or a malignancy, but the weight of the evidence is in favor of its being malignant."

On the basis of this roentgen report a partial gastrectomy resection was performed by Dr Blank by Bill-

roth II procedure. From a study of the films it is evident that it would have been almost impossible to have removed the stomach above the proximal edge of the induration. The patient's symptoms continued and an x-ray examination on June 16, 1924, showed marked obstruction and 24-hour retention due to closure of the gastro-intestinal stomach. At that time I was unable to detect any evidence of a tumor mass in the stomach obstructing the stomach. Subsequently Dr. Blank reoperated and did a gastro-enterostomy, carrying a long loop of jejunum to the remaining portion of the stomach.

The patient was finally discharged from the hospital on February 10, 1925, almost a year after her admission. During that time she had had three x-ray treatments of 5 minutes each with 150,000 kilovolts and 3 millimeters of aluminum. This made a total of 15 milliampere minutes.

A microscopic examination of a section of the lesion (Fig. 6B) was made by Dr. McWhorter who recognized the findings as unusual and made the following pathological report: "Diagnosis of sarcoma of the stomach. He was sustained in this diagnosis by 6 other pathologists' friends of his to whom he rather informally showed this section. A short time later Dr. L. Ing was in consultation on another case at the hospital and I asked him if he wanted to see a sarcoma of the stomach. Thinking that I referred to the x-ray, he exclaimed, 'Yes, I certainly do!' He was surprised when we brought him the microscopic sections and then he said—

'No, this isn't sarcoma. This is carcinosarcoma undifferentiated and very malignant.'

With these two divergent opinions as to the type of the lesion, the section which had been examined by Dr. Ing was presented to Pappheimer, who during a cursory examination looked at the section and said that it was a granuloma, non-malignant, and handed the slide back to me. I smile or some other look on my face led him to inquire why, and I told him Dr. Ewing had seen this section and had made a diagnosis of cancer, which prompted him to grab the slide and look at it again. At that time he said he was going to extract his hasty opinion and that the slide wasn't good enough to justify a diagnosis. I happened then to ask him to get the block from Dr. McWhorter and he had his technician cut and stain several sections. He was as usual unwilling to make a diagnosis because the block was improper. I mentioned so he remounted the block and made additional sections (Fig. 6B) and made a diagnosis of undifferentiated and very malignant.

thus confirmed the diagnosis which he knew. This difference of opinion regarding the type of lesion added the usual appearance caused me to conclude the microscopic section among those which he subsequently presented to the pathologist. On this list of all of whom a thorough section opinion as almost unanimous that the lesion was malignant. Only one pathologist, Konzelmann of Temple, made a definite diagnosis of non-malignant. Lacassagne of Lausanne did not commit himself

as to malignancy or non-malignancy, but he suspected it was not malignant nor did he commit himself to an opinion as to the type of lesion. Of the twenty-two who maintained that it was definitely malignant there was a wide variation of opinion as to the type of lesion.

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Bert and m		S. ma	d lymphosarcoma
Arch arcu m		M	Whorter lymphosarc m
Foot caru m		I ppe	h mer ca m ?
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M rtd d mal gna t			

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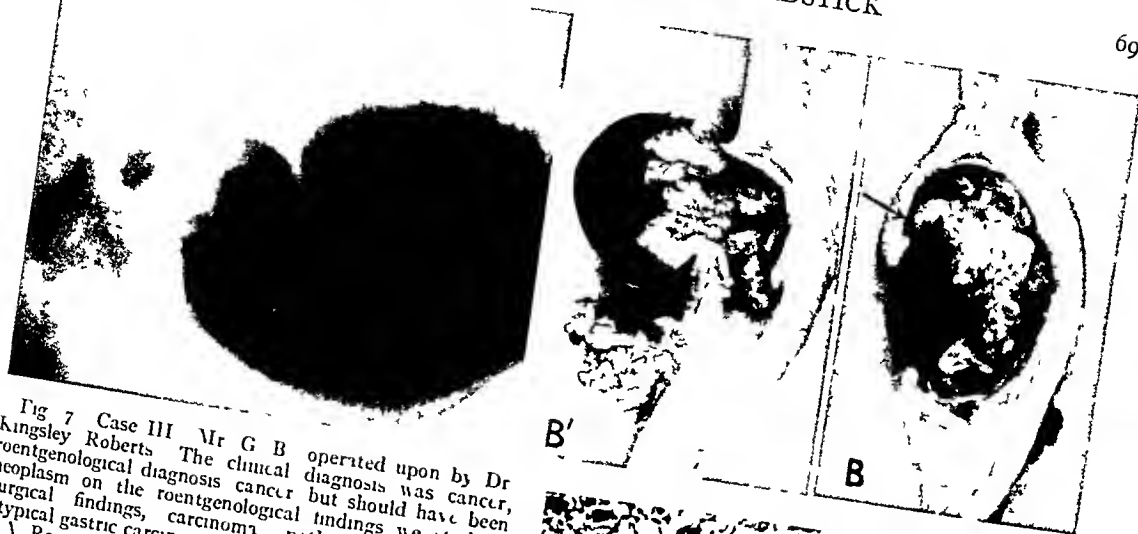
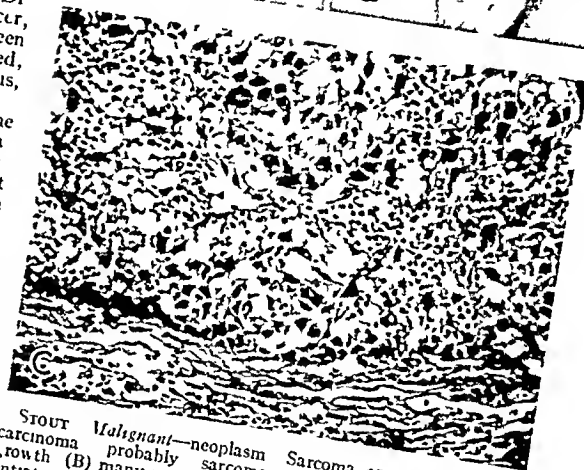


Fig 7 Case III Mr G B operated upon by Dr Kingsley Roberts The clinical diagnosis was cancer, neoplasm on the roentgenological findings we studied, atypical gastric carcinoma

A, Roentgenogram showing the spherical tumor on the greater curvature near the pylorus with superficial ulceration B'. Photograph of a gross subsection of a sleeve resection of the tumor mass projects into the lumen of the stomach and is ulcerating into the peritoneal cavity. B, Part of the tumor projects into the peritoneal cavity. A small crater shown in the neoplasm. C, Medium power photomicrograph of a



STOUT Malignant—neoplasm Sarcoma or undifferentiated carcinoma probably sarcoma. Criteria—(A) Infiltrative growth (B) many mitoses (C) no secretion of mucin or differentiation into glands (D) possibly reticulum cell sarcoma from reticulum of stomach lymphoid tissue

The clinical and x-ray diagnoses were equivocal. We did not know whether the lesion was malignant or not. But measured by the pathological yardstick (by 23 out of 24 pathologists) it was malignant, viciously malignant. The x-ray man could not be expected to see the cancer cells or tell whether the ulcer was malignant or benign. The patient is alive and well at 12 years.

The tremendous preponderance of opinion in favor of malignancy, even though there was great diversity as to the type of lesion, reminds me a little of the admiring mother who said that everybody was out of step except Johnny. In this case Johnny was Konzelmann, who elaborated his criteria more

# MALIGNANT

BRODERS Malignant—odd lesion for stomach not a carcinoma. Criteria—Not given.  
 MISSEY Malignant—lymphosarcoma. Criteria—Diffuse infiltration of mucosa submucosa and muscle layers by round cells.  
 SIMARD Malignant—histologically malignant—lymphoblastic. Criteria—Diffuse infiltration of muscular layers very poor section—above statement impression only.  
 McWHORTER Malignant—probably malignant—mildly sarcoma lympho type. Criteria—Have seen too few of these to know anything about the follow up.

## MALIGNANT QUESTIONABLE

PAPPENHEIMER Very malignant—carcinoma—undifferentiated malignant (6 years later—lymphosarcoma). Criteria—Not given at first examination. Recent study (6 years later of same section faded in meantime). I cannot make a positive diagnosis but am inclined to regard tumor as lymphosarcoma because of diffuse infiltration without destruction of epithelium.

than all others he knew his left footstep was on the impulse beat of the music

**CASE III** Mr G B admitted to the Fifth Avenue Hospital in June 1931 Patient of Dr Kingsley Roberts Following is an excerpt from the roentgen report After a barium meal there is evidence of a tumor mass in the pyloric end of the stomach near the pylorus (Fig 7A) This is located in the region of the greater curvature There is evidence of a crater in the center or near the center of the mass The tumor mass is somewhat circular in shape and presses into the lumen of the stomach when the patient is in the prone position I believe that the weight of the evidence is in favor of this being a carcinoma I resent review of the report when writing this The only evidence in this report of its being an x ray joker is the wording in the first clause—A tumor mass—also the next to the last clause should read—according to the doctrine of chance this should be carcinoma but the x ray criteria is in favor of its being something else at least an x ray joker

A pyloric resection by Dr Roberts revealed a gross lesion (Fig 7B) that was as unusual as the roentgenological findings The gross specimen viewed from within (Fig 7B) and also on cut section showed findings almost identical with the x ray findings A large adequate well stained section (see Fig C) as considered non malignant by Konzelmann and malignant by all the rest of the pathologists

Their findings are as follows—

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	Rh arcoma
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**Clinical and x ray diagnosis equivocal** Measured by the pathological yardstick, the type of lesion is still equivocal—he should be dead of malignancy but he is alive and happy at 6 years

Ewing and Stewart the first time they saw this section both temporarily avoided committing themselves concerning the type of lesion but later they both described it in detail as given above

There is a preponderance of opinion in favor of malignancy or at least neoplasm equally divided into carcinoma or sarcoma

**CASE IV** M J C In this case the incident as occurred with the retrological examination is similar to the first viz the microscopic examination indicated the x rays wrong The examination (Fig 8A) showed definite in the lesser curvature of the stomach about which there is a difference of opinion among those of us who were

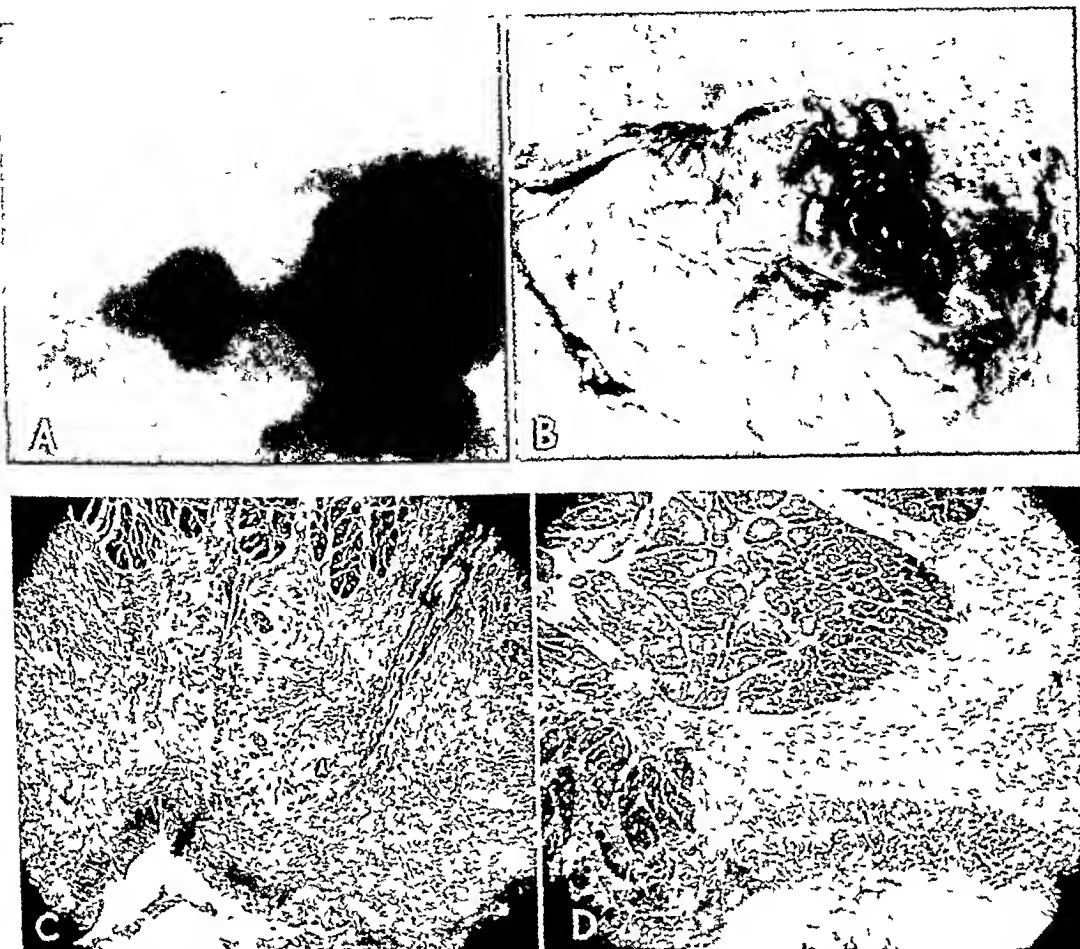


Fig 8 Case IV, Mr J. C., operated upon by Dr Frederick Bancroft. The clinical diagnosis was ulcer, roentgenological diagnosis, cancer, surgical findings, ulcer, pathological report, simple benign ulcer, in spite of pressure being brought to have the pathologist change it.

A, Roentgenogram showing lesion near the sulcus angularis with a superficial area of ulceration and a large area

of induration. B, Photograph of the outside of the specimen showing the peculiar tumor resembling a bunch of grapes. C, Photomicrograph from the distal half of the ulcer bed showing a definite orthodox evidence of the presence of cancer. D, Photomicrograph of the proximal half of the ulcer showing that there is no orthodox evidence of cancer.

associated in our practice of roentgenology. The report of the x-ray examination is as follows:

Roentgenograms of the gastro intestinal tract immediately and 6 hours after a barium meal show an indurated lesion on the lesser curvature of the stomach and the pyloric end of the stomach just distal to the sulcus. It is about 2 inches proximal to the pylorus. There is no definite crater that can be shown at this time. There is an indentation on the greater curvature surface opposite this lesion. This area is fixed and in the present films the proximal portion of the stomach overrides and obscures the area. We believe that this is an infiltrative lesion involving the lesser curvature surface in the region described. It is either the result of a former gastric ulcer with fixation and adhesions or malignancy. The weight of the evidence is in favor of malignancy. The pylorus is in a state of contraction and we believe that this area is also fixed from some irritation or some former process. There is no obstruction.

One of us (L. G. C.) stood out for a diagnosis of carcinoma while others were unwilling to go further than a diagnosis of an organic lesion of a neoplastic type. The patient was operated on by Dr Bancroft and at the time of the exploration the lesion observed roentgenologically was readily detected. Dr Bancroft considered its external appearance unusual and, on palpation, the lesion did not have the stony hardness considered characteristic of a carcinoma. A partial gastric resection was done, and the specimen prepared in a special manner by filling it with low-melting point paraffin. It was then cut longitudinally through the center of the crater (Fig 8B). I retained  $\frac{1}{2}$ , the attending pathologist, Dr Jessup, took the other

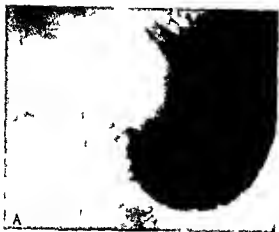


Fig 9 C VIMAW The 1 diag s  
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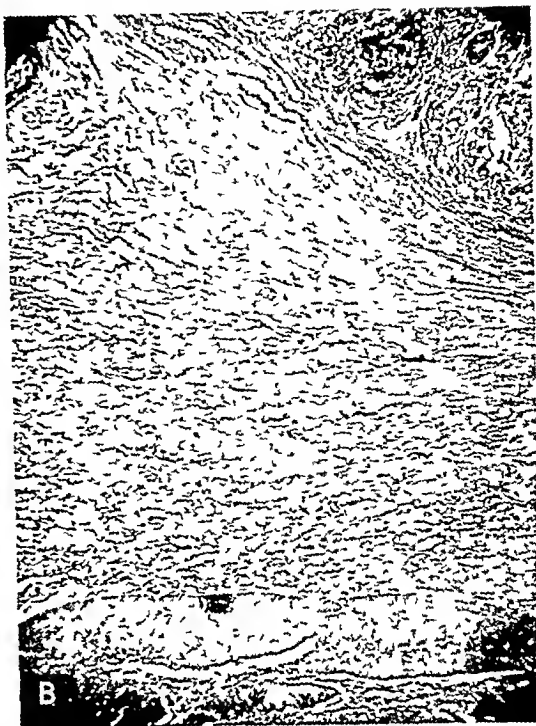
The path l g cal report g ve by Dr Jessup was  
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base of the u l c e r were m a l l g n a n t X r a y d a g s s





Fig 10 Case VII, Mrs D, operated upon by Dr Kingsley Roberts. The clinical diagnosis was gastric ulcer, the roentgenological diagnosis, gastric ulcer, not a simple type surgical findings, gastric ulcer, pathological diagnosis gastric ulcer. The sections submitted to the pathologist were not at the crater but included the submucosa on the greater curvature which shows tremendously thickened and infiltrated tissue.

A, Roentgenogram showing a large ulcer on the lesser curvature with irregular crater and extreme irregularity of the mucosal pattern on the greater curvature from which region the microscopic section was removed. B, Photomicrograph showing submucosa thickened and infiltrated. The circular muscle coat is at the bottom of the illustration.



The muscularis mucosa and base of the submucosa is at the top. The type of tissue in the submucosa was the pathological question under consideration.

gastric cancer (L G C) clinical and surgical diagnosis equivocal. Primary pathological report, simple ulcer, no cancer. I was wrong as measured by the primary pathological yardstick—but 24 other pathologists all said it was malignant. Their diagnosis did not go on the chart. The man applied for life insurance and the only pathological report said it was not cancer. I don't know if he got it. When this section was presented to Ewing and Stewart, Jessup was supported by both, according to reports signed or initialed by each of them. The lesion (as shown in Figure 8C) was considered malignant and the type carcinoma by all other observers. The fact that 21 of these 24 men considered this lesion either definitely malignant or suspiciously malignant, is of special significance, particularly when associated with our subsequent consideration of types of ulcers which are malignant or tend to become malignant.

In discussing this initialed report, Ewing brought out at our coordinating conference a fact that is well worth consideration and therefore will be herein elaborated upon more than it seemingly deserves. Ewing, in defense of his initialed report, stated that this slide must have been shown to him late in the afternoon or without his having given it careful consideration. Under these circumstances I fully appreciate that he should not be held responsible for this

diagnosis because we well know one is frequently asked to give curbstone diagnosis—the pathologist on a microscopic section and the roentgenologist on someone else's x-rays and in most of these cases, be they sections or roentgenological findings they should be given the greatest attention because usually they are either pathological or roentgenological jokers. In this case, therefore, the sections were later presented to Ewing and Stewart at which time they gave them the most careful consideration and reported them an unmistakable cancer with definite well defined differentiated groups of epithelial cells well down in the bed of the ulcer.

#### NON MALIGNANT

Jessup simple benign ulcer  
Ewing (?) benign ulcer small  
area questionable  
Stewart (?) ulcer with some  
atypical glands

#### MALIGNANT

Ewing (?) carcinoma  
Stewart (?) carcinoma  
Geschickter carcinoma  
Aschner carcinoma  
Bell adenocarcinoma  
Mallory adenocarcinoma  
Parker adenocarcinoma  
Foot adenocarcinoma

Martland adenocarcinoma  
McWhorter adenocarcinoma  
Robinson adenocarcinoma  
Gray adenocarcinoma  
Lacassagne adeno epitheli-  
oma  
Konzelmann adenocarcinoma  
Bertrand epithelioma  
Stout cancer on ulcer  
Klemperer cancer on ulcer  
Pappenheimer cancer on ul-  
cer  
Pritchard cancer on ulcer  
Rhea, cancer on ulcer  
Masson cancer on ulcer  
Simard cancer on ulcer

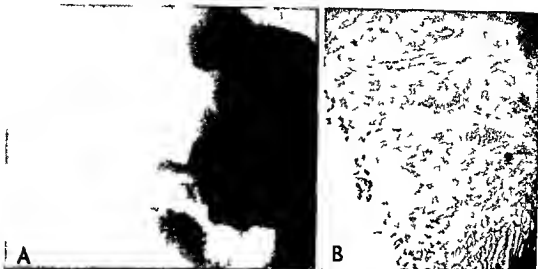


Fig 11 C e \ III Mr P S refe ed by D And e s  
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M T—C CE TC  
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ul C t a—C can m p se t d b j fil t t e  
gro th f typ cal gla ds  
A l e ar Mal g t—m t p b bly ca ba f d  
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gl d lar l l floo f l (B) ar t h pe d  
g m t f l l s (C) g lar t bul p od t m t f  
l l s (D) ur gula typ cal m t  
MA TLA T Mal g ni—d oca ci m Crter a—\ t

P r m M Mal g t—hr l h h d ocar  
m d l p ng t d C t —\ t g f d l p s  
d ocar m t nd f h th cr t e a.  
I r cu up Mal g t—denoc m m m ung the  
m os t marg f l c te d ng back t b m cosa d  
l ng l t l w l l l t m l pe m p sed  
ch l C t rse—\ t g

M W r Mal g t—d ocar m m Crter —\ t g  
t d g b m co d m s c l th gland l p th l m  
R con M l g t—ad ca m C t rse—\ t g  
l t fil t r g m scl d f m ng p se d gl nd Appe r s  
t bed l p ng th marg f hr l  
C Mal g ni—d oc ma C rse—\ t g  
th m g l l m m t r y t f th l cum bed  
area fan plast gl d l gr th Ex pt f d fuse filtra  
t g th th cr t m l g cy p se t Ther  
l f pol ty t ze f l l ased hr m tu  
l cl ar bat d m t (B) ther lymph d d po ts  
(C) the b t light r s t m bry al type f cell, t  
w l d be l s s fied Grad Wh h ca m  
f h n u t f th t mach M t m t a t a z  
th mooted q est

R Mal g t—c ma m sa t m g f lce  
t d g b k l ng th b m cosa d l ng l a l l l f l  
t d mus l C t rse—\ t g  
M so Mal g t—p b bly l oc d phr gm type.  
C t —\ t g  
S x M l g t—lce and m C te —\ t g  
d f th l h c aom t cer n ed lcer If not  
d phr gm l t ng ca l roca oe

This section does not seem to be of interest except for the fact that the previous pathological diagnosis based on microscopic section indicated that the x ray diagnosis was wrong and that diagnosis would have stood in

spite of efforts to get the pathologist to change it, if the section had not been presented to twenty-two other pathologists. But, when combined with the next section, it serves as a very important link in a chain of evidence on the criteria of growing tissue which is the subject of a second article soon to be presented.

The fifth microscopic section presented (Fig 8D) was the other half of the same lesion as described in Case IV (Fig 8 A,B,C). The ulcerating area and its surrounding area of induration was rather large for a single mounting and therefore it was cut in two directly through the center of the crater, half of the lesion being mounted on one slide and the other half on another slide.

In presenting this other half of the section, without the pathologists knowing it was the opposite half of the section they had seen before, I have been accused of trickery which has aroused more or less the ire of some of the pathologists. I can only say in sincerity that this was done, not with the object of tricking or catching them in the diagnosis, but it was done for 2 distinct reasons.

First, to demonstrate a fact well known among pathologists, namely, that a section from the center of the bed of the ulcer out through the lip of the ulcer is the type of microscopic section and the extent of the microscopic section that is observed by pathologists in the *vast majority* of cases that come through the laboratory as the routine microscopic examination. I am well aware that in controversial cases a more elaborate procedure of examining serial sections from sections made radially from the center of the crater in all directions is the procedure that would be used. But, on the other hand, only one of these 8 cases was primarily considered by the pathologists as anything other than a routine examination when the case was finally closed by him in his formal report to the hospital, this one exception being sections Nos 4 and 5 now under consideration.

This statement concerning a single section from the gross specimen is evidenced by the observation of gross specimens in various pathological laboratories of which I had made a tour with intent to view the gross pathological specimens for two purposes. First, to deter-

mine the surgical mortality as the result of the removal of the specimen and second, to determine the extent of microscopic examination on which the pathological report is based.

My second excuse for presenting this second half of the section to the pathologists is the most important, namely, it serves as a connecting link in the pathological proof that ulcers which are said by some to become malignant have 25 points of differentiation from those that do not have a malignant tendency. With this latter point in view an analysis of the reports of these 23 pathologists concerning this second half becomes of paramount importance because as it is seen in the following tabulation only three of the 23 pathologists considered this second half of this ulcer anything other than that of a simple garden variety ulcer (see Fig 8 A, B, C, D)

NON MALIGNANT

Mallory ulcer  
Parker ulcer  
Lacassagne ulcer  
Simard ulcer  
Aschner ulcer  
Klemperer ulcer  
Pappenheimer ulcer  
Gray ulcer  
Geschickter ulcer  
Stout ulcer  
Foot ulcer  
Konzelmann ulcer  
Martland, ulcer  
Rhea ulcer

Robinson ulcer  
Stewart, ulcer  
Bell ulcer  
McWhorter, ulcer

Bertrand type not stated  
Pritchard, marginal mucosa hypertrophy  
Ewing, not true cancer obviously

MALIGNANT

Jorstad adenocarcinoma  
Masson ulcer with atypical cells  
Ewing, changes toward cancer

NON MALIGNANT

MALLORY Non malignant—ulcer Criteria—Not given  
PARKER Non malignant—ulcer Criteria—Not given  
LACASSAGNE Non malignant—ulcer Criteria—No malignant tissue  
SIMARD Non malignant—ulcer Criteria—Fixation and staining cannot permit study of one edge of the ulcer  
ASCHNER Non malignant—ulcer Criteria—Not stated  
KLEMPERER Non malignant—ulcer Criteria—Not stated  
PAPPENHEIMER Non malignant—gastric ulcer Criteria—Not stated  
GRAY Non malignant—gastric ulcer with quite denuded area lined by fibrotic material Criteria—In the margin of the ulcer there is the usual hyperplasia of the glands and inflammatory cellular infiltration. There are some hyperchromatic detached regenerative or degenerative epithelial cells but no more than might be expected in a chronic inflammatory reaction of this sort

GESCHICKTER Non malignant—ulcer penetrating Criteria—Not stated  
STOUT Non malignant—penetrating ulcer Criteria—(A) Considerable inflammatory reaction in the base and in the surrounding mucosa (B) remarkable hemorrhages in adjacent mucosa and submucosa with phagocytosis of blood pigment  
FOOT Non malignant—subacute ulcer (acutely inflamed chronic ulcer) Criteria—No neoplastic cells found, any metaplasia at rim of ulcer may be explained on basis of response to irritation  
KONZELMANN Non malignant—chronic ulcer Criteria—Nothing suggestive of neoplasm Regeneration and degeneration (inflammatory) epithelial cell changes

MA FLAND \ mal g ni—chron ulc Crater—N t  
 tated  
 KUEA \ m l e ni—chr ulce marg alm cosa hype  
 t phy C lerna—\ t g n  
 K \ m l g ni—chroni lce br n gastriti  
 C lery—This l d that fa h n ul h h h  
 m ry som ep th lal l that jumbled b t Th I believe  
 pa t oc ss d t d f m hg any  
 St w \ m a g t—chronic g st ulcer ro ded  
 by ea f hyper ph gastriti gl d light typ al C r  
 ter \ t t ted pt as type l d h to call th ulcer g  
 ca b t do t hnd any l d cat that t Sumpl hro

B L Non-mal gnant—benig bro ulcer Crater—  
 Lymph t nfil t l floo part Th layer f M  
 e ul t tisa e part f th floo  
 M W o t \ m a g ni—badly unph ulc f m  
 what ca be see f th se t Crater—\ t tat d  
 HER EA D \ m a g ni—type t t ted Craters—\  
 f m aligna cy  
 PAIRCA \ m a g ni—th m gn al m sa  
 hyperph b t ca ci m Craters—\ t m gn  
 E \ m a g ni—fused t tat yes  
 ni g malignancy Type f les t tru ca ce b so sly  
 Crater—Cells typical r y ma ked hyperph gastriti  
 atypal b g f l th lip l th m cosa t e essary  
 m lga t Pecular som respect especilly th g wth  
 f th gland l l ing mark was H d d t d f ca  
 ee d d h Lat he said it has pec har ppe e som  
 hara t n tica f ca cer ha chang th typ l ch g  
 t d ca hich possibl t no d ung t t du  
 nary imple ulcer

It was considered malignant by Jorstad and  
 Masson and considered changing toward  
 cancer by Ewing The names of these men  
 are recorded in the order of their assurance of  
 its being malignant

MALIG  
 J AD Mal g ni—ther G d —Aden c ma  
 Craters—Th marked pling f th gl dular p h t m  
 t th dg f th d ded ea Th m d ease  
 th t b la t t t t t po t lmo t polyo f m t  
 b t t th base f th pol po th d hant as  
 f th muscular by gl d t b les wh b h w cells with  
 hype bromat clei d occas nalm t Th G d  
 —Vl oca m Th base f th l h p th lal  
 l g Th lay ho th musc i ma ly scar t e  
 whi bi ry scula Th ryliti od l tlt t  
 and th lim ted th pper t t d th d h te b  
 se f ro d l l tr t bo t th mer mall ad  
 theall paces thr gh t lund ev d f malignancy  
 th b se l th l

Ml so M a g ni—Yes type ungl ulcer th gro p f  
 t ryal lls previt t th m cosa ca th ulcer f  
 th l m os essel p baily lymph t c co t ng l  
 m no ad typ l cell Craters—Further c t g  
 L t M a g ni—fused t t t yes no ero  
 g malignancy Type f les not tru can b ously  
 Craters—Cells ryal r y ma ked hype t phs g tri  
 At t l chs of cells the lip l th m cost not cressanly  
 mal g a t l t e c f som respects especilly th  
 g wth f th gla t l l dlo g m k was l l dnoted f  
 ca ce d d h t lat h said It b pec har types  
 som chara terist of can has hanges that re ty l  
 hanges t and t h are exosible f mder g t  
 not dinary imple ker

Jorstad is placed first of those who con-  
 sidered this second half of this section as ma-  
 lignant because of the fact that he definitely  
 stated that it was malignant furthermore  
 calling it Adenocarcinoma—Grade 1 He

elaborately recorded the criteria on which  
 this opinion was based

Masson was placed second on the list be-  
 cause of the fact that he stated unequivocally  
 that the lesion was malignant However in  
 stating the type of lesion he did not use the  
 word carcinoma or cancer It must be under-  
 stood however that we were conversing  
 through an interpreter In his written report  
 on the criteria I think he believed it to be car-  
 cinoma although he did not pecitically say  
 so He refers to it as a simple ulcer with  
 group of atypical cells which are described  
 under type of lesion and in the second clause  
 in the submucosa a vessel (or channel)  
 probably lymphatic contains a voluminous  
 amount of atypical cells My analysis of  
 this statement would lead me to believe that  
 he considered this a simple ulcer on which the  
 additional criteria described led him to be-  
 lieve there was a malignant degeneration

Ewing was unwilling to say Yes or No  
 and then made the following statement  
 namely that there is no definite clear cut  
 well defined line between a lesion which is  
 malignant and one which is not malignant  
 He intimated the term Precarcinomatous  
 might be applied to these borderline cases  
 He was incensed perhaps justly so that I had  
 asked him to study intently this second half  
 of this section which he had seen I believe  
 however incensed as he might have been by  
 what he considered trickery that these  
 carefully recorded remarks concerning this  
 section particularly his statement—There  
 is no well defined clear cut line between malig-  
 nant and non malignant lesions and his  
 chain of thoughts as evidenced by his dis-  
 connected statement will eventually cause this  
 to be one of the most important pathological  
 reports that he ever made

All except three pathologists considered this  
 a non malignant ulcer yet they nearly all  
 agreed that the other half of the ulcer was  
 malignant There was a tumor mass having  
 unusual microscopic criteria with characteris-  
 tic carcinomatous cells on one side and not on  
 the other Was the tissue adjacent to the car-  
 cinomatous cells part of the carcinomatous  
 growth new growth tissue or was it inflama-  
 tory similar to that seen in the bed of an

ple benign ulcer? *That is the vital question that makes this section well worth studying*

CASE VI Mr A W is perhaps the most important of this group, at least from my roentgenological and pathological observation

On September 8, 1923, we made a negative diagnosis of lesion of the stomach and a positive diagnosis of postpyloric ulcer and cicatricial contraction of the cap. There was, however, no definite crater present. There was no pyloric stenosis and the stomach evacuated itself in normal time.

On December 23, 1930, seven years later, the report on the case shows the following findings, excerpts of which are here quoted (see Fig 9A) — "In the lower part of the corpus of the stomach there is a small ulcer and immediately above this is a second area of induration. Below the ulcer there is considerable inconstant deformity of the antrum and pyloric canal. The cap is quite normal in appearance. *Diagnosis* From a study of these roentgenograms I believe one is justified in making a positive diagnosis of organic lesion involving the pyloric end of the stomach and lesser curvature at the lower end of the corpus of the stomach. I believe that the varying gross deformities of the distal end of the stomach are due to scar tissue from previous or practically healed ulcer. Just above this on the lesser curvature is a small ulcer the excavation of which apparently extends down into the mucosa. Adjacent to this is a second area of induration which may be broad mucosa erosion or the beginning or end stage of a deeper ulcer. The findings as observed in these series of roentgenograms are not at all indicative of new growth. At the present time there is no evidence of previous deformity of the cap. There is slight functional gastric retention. There are no duodenal diverticula and the passage of the barium meal through the small intestine is normal. The appendix is patent and filled readily with barium."

A review of these films with the knowledge we have since acquired, would lead us now to consider this case as definitely one of the roentgenological jokers and the majority of roentgenologists who saw this series of films are of the opinion that the lesion is malignant, as based on the roentgenological findings, in spite of the fact that I did not so regard it at the time of our second examination.

The patient was operated on and died within a few days. The lesion (as shown in Fig 9C) was considered non-malignant by all the men except Masson and he made a positive diagnosis of malignancy and gave his criteria on which he based his diagnosis. So far as I could get the criteria on which the other pathologists based their negative diagnoses of carcinoma on this case they have been recorded. Lwing stopped as he was studying this section, wiped off the slide and his lenses and

remarked that there were some slightly atypical glands which might be regarded as precarcinomatous. He was the only one who in any way supported Masson in his positive diagnosis of malignancy. I believe that this section will probably go down in history as one of great significance, certainly of greater significance than any section it has been my privilege to study. And this section will be the subject of another article which I hope to publish later under the title, "Microscopic Criteria of Growing Lesions," in which communication, I am prepared to state that in spite of twenty-three out of twenty-four opinions to the contrary this section has none of the characteristics of simple benign ulcer.

NON MALIGNANT		Pappenheimer ulcer (chronic peptic)	
Lacassagne ulcer		Foot ulcer	
Mallory ulcer		Kiemperer, multiple ulcers	
Parker, ulcer		Stout multiple ulcers	
Simard ulcer		Robinson multiple ulcers	
Aschner ulcer		Gray ulcer (duodenal)	
Geschickter, ulcer (simple peptic)		McWhorter ulcer	
Jorstad ulcer (benign)		Bertrand, type not stated	
Konzelmann ulcer		Ewing (?), multiple ulcers	
Martland ulcer			
Rhea ulcer			
Pritchard, ulcer (chronic active)			
Stewart ulcer			
Bell ulcer (benign)			

NON MALIGNANT		MALIGNANT	
LACASSAGNE	Non malignant—ulcer	Criteria—Hyperplastic, edematous	
MALLORY	Non malignant—ulcer	Criteria—Not given	
PARKER	Non malignant—ulcer	Criteria—Not given	
SIMARD	Non malignant—ulcer	Criteria—The edges of the ulcer cannot be studied	
ASCHNER	Non malignant—ulcer	Criteria—Not stated	
GESCHICKTER	Non malignant—simple peptic ulcer	Criteria—Normal mucosa to area of ulceration. No invasion of surrounding tissue. Normal without irregularity of cells.	
JORSTAD	Non malignant—benign ulcer	Criteria—(A) Base of this ulcer is made up of chronic inflammatory tissue that is practically scar formation. There is moderate multiple abscess formation in the subserosa. (B) mucosa at the edges of the ulcer is slightly piled up, but the tubules have a distinct outline. The nuclei are not deeply stained and there is a striking feature that at each edge just at the base of the epithelium is an area of inflammation which quite well accounts for the hyperplasia.	
KONZELMANN	Non malignant—chronic ulcer	Criteria—Nothing suggestive of a neoplastic infiltration. Suppuration of mucosa. Chronic ulcer. Part of wall cut on bias.	
MARTLAND	Non malignant—chronic ulcer	Criteria—Numerous eosinophiles.	
RHEA	Non malignant—chronic ulcer	Criteria—	
PRITCHARD	Non malignant—chronic active ulcer	Criteria—No tumor.	
STEWART	Non malignant—chronic gastric ulcer surrounded by polypoid growth of mucosa	Criteria—Not stated.	
BELL	Non malignant—benign chronic ulcer	Criteria—(A) Extends deeply into muscle. (B) subacute inflammation deep under center floor.	
PAPPENHEIMER	Non malignant—chronic peptic ulcer	Criteria—Ulcer shows no unusual features except rather marked eosinophilic reaction.	
FOOT	Non malignant—chronic ulcer	Criteria—No neoplastic cells are present in the ulcer area.	

NON MALIGNANT—MULTIPLE ULCERS	
KIEMPERER	Non malignant—ulceration (multiple) evident. Possibly ulcerative gastritis. Criteria—Not stated.
STOUT	Non malignant—not a neoplasm. Two ulcers. Criteria—Marked gastritis marked inflammatory reaction in both.



between a simple ulcer and an ulcerating new growth. About sixty per cent of these cases are new growth and the findings in the two hour examination somewhat indicate the fact that this is an ulcer in a new growth. I believe that we should re-examine this case in about 2 weeks to determine if possible the exact character of this lesion.

The attending surgeon, Dr. Andrews, who referred the case to me was taken seriously ill before the patient returned to him after having the x-ray examination and he did not leave his work in charge of anyone. Thus the patient did not receive this report or learn of its contents.

More than a year later, on February 3, 1926, the patient returned directly to me and inquired concerning what we had found the year previous. I was surprised and shocked to know he had not received our original report and immediately made another examination and the following is a report of our findings.

**Roentgen findings.** A serial examination made of the gastrointestinal tract immediately after the ingestion of a barium meal shows the size, shape, and position of the stomach and the passage of the barium through the tract.

Stomach is hypertonic. Peristalsis three cycle type equal on greater and lesser curvatures except at the extreme pyloric end of the lesser curvature. Systole and diastole shown fairly distinctly. Pars pylorica fails to expand and contract in a normal manner, particularly on the lesser curvature, close to the sphincter. Cap somewhat deformed rather larger than normal. Duodenum, Jejunum and Ileum shown distinctly. At the two hour period the stomach is about half empty and the head of the column is in the terminal ileum.

**Diagnosis.** From a study of these roentgenograms I believe that one is justified in making a positive diagnosis of a pathological lesion involving the extreme pyloric end of the lesser curvature of the stomach. In this region I believe the mucosa and the muscular coats are attached to each other in such a way as to interfere with the gastric peristalsis and that the mucosa raises up into a fold just proximal to this area. I believe that the pouch which I interpreted as a crater in the previous films is due to this fixation between the muscular and mucosal coats.

There is a bare possibility that this area may be malignant but I do not believe there is sufficient roentgenological evidence to justify one in making a diagnosis at the present time.

Dr. Eugene Pool was consulted and when he saw the second series of films and read these two reports, he said, "Cole, can you say with certainty that this lesion is not malignant?" My answer was in the negative. His next remark was, "Then we will have to look in and see. I thought you maintained that by an x-ray examination you could determine whether a lesion was or was not malignant." Shortly after this the patient was operated on by Dr. Pool and as I entered the operating-room he introduced me to the visiting doctors as having been a great roentgenologist but that I must be getting senile because I used to be willing to make a positive diagnosis of cancer, whereas, in this case, I was unwilling to do so. At this stage of the operation he was able to observe and palpate a relatively large mass involving the pyloric end of the stomach which he said was undoubtedly cancer, and wondered why there was any hesitancy on my part in considering it so. I still maintained that from a roentgenological standpoint it was not typical of gastric cancer. Sections were

prepared and were to be ready for study the following Friday morning. I was there bright and early before the pathologist had studied them. He then examined them carefully knowing that there was a controversy and made a negative diagnosis of cancer saying that it was a "simple ulcer." Pool was asked to come down from the wards and go over the sections with us and he attempted to persuade the pathologist, but Dr. Denton could not be budged in his opinion that it was a simple ulcer. This was in the latter part of May and the following October when I again took up the study of the "Correlation of Pathology and Roentgenology" I went to the hospital to get the gross specimen for photography. I then found that Dr. Denton was no longer the pathologist at the institution and that the gross specimen could not be found, that a microscopic section could be found and the diagnosis, at least in the registry had been changed from "ulcer" to "sarcoma." I then found that the pathologist had taken two microscopic sections, of which he gave me one (Fig 11B) which was the better of the two. This section has been submitted to all twenty-four pathologists.

Some time after this when Pool more or less facetiously joshed me about some other incident, I recalled this incident and he maintained that the records never had been changed as they appeared on the chart and that Ewing had seen the section and had called it "sarcoma." At our co-ordinating conference Foot resented the insinuation and finally after a diligent search, found the block from which microscopic sections had been cut and had additional sections cut which we subsequently had stained with various stains but the diagnosis of the twenty-four pathologists was based on the same microscopic section that I originally obtained from Dr. Denton.

NON MALIGNANT	MALIGNANT
Lacassagne ulcer	Ewing carcinoma
Mason ulcer	Foot carcinoma
Jorstad, ulcer	Bertrand carcinoma
Sumard ulcer	Stewart, carcinoma
Martland ulcer	Gray adenocarcinoma
Pappenheimer ulcer	Rhea, ulcer secondary malignancy
Robinson ulcer	Pritchard, cancer on ulcer
Stout, not simple ulcer	Broders sarcoma (lympho)
Konzelmann chronic ulcer	Geschickter, sarcoma (lympho)
Klemperer pseudo leucemic or leucemia	Bell sarcoma (lympho)
Aschner ulceration lymphomatous lesion	Mallory lymphoblastoma
McWhorter inflammatory probably syphilis	Parker, lymphoblastoma

NON MALIGNANT
LACASSAGNE Non malignant—ulcer simple. <i>Criteria</i> —Not given
MASSON Non malignant—ulcer. <i>Criteria</i> —Inflammatory nodules in the thickened submucosa between the muscles. A few atypical cells but too poor fixation to say more
JORSTAD Non malignant—ulcer. Benign. <i>Criteria</i> —(A) Margins of ulcer are clear cut (B) moderate hyperplasia, (C) dense round cell infiltration throughout the base of the ulcer
SUMARD Non malignant—ulcer. Benign. <i>Criteria</i> —Poorly fixed and stained. Poor section
MARTLAND Non malignant—ulcer. Benign chronic. <i>Criteria</i> —Not given

## TABLE 1—DATA REGARDING SPECIMENS EXAMINED

I t	N m	Ques les na	Diag on	F the log cal material		Surg	H talid
				Gross	Micro- sc job		
Es ly	U h		Gast ac lee			Gers er	M S sau
Early	U h		Cas ac lee			Ge lee	M S
Early	U K		Gas ac lee			Gers	M Sina
Early	U h		Gas ulcer			Gerser	M S
Es ly	U K		Gastric ulcer				C kn
Early	U h		Gas ac lee				U h wa
Early	ss	?	?				C k
Early	ss	?	?				C know
Es ly	U K		C ne				Broadly
Es ly	Mrs C		Gas ac lee			Edm	C kw
Early	U K		Angiosarcoma			Lo ry	C k
Early	M P		Gas ulcer			U Lipp	U Lipp
Early	M S		Gastric k			B r	M S sau
Es ly	Mrs W	P Soc H	?			Sla k	Fre h
Es ly	M S	P Sect III	?			Paul	N S k
Es ly	M V		Cane			Ho	Fid h Ave
Es ly	Es h		Gas ac l				N I k
Es ly	M P		C ac				French
Es ly	Mrs C	?				Vancro	Fid h A
Es ly	M D		Cane				F h A
Es ly	M S		C k				Fid h Ave
Es ly	U h	?					Perkins S
Es ly	Mrs O		Gas ac lee			Edm	
Es ly	Mrs C		L.oma oculo				
Es ly	M R		N. mal stomach				Fid h A
Es ly	Mrs D	Sec H	?			Roberts	Fid h A
Es ly	M R		Gas ac lee				Fid h A
Es ly	M I		Cancer ulcer				
Es ly	Mrs G					Ramsdell	
Es ly	M G		C			D. nec I	Fid h A
Es ly	H G S	?					Leon H II
Es ly	Mrs C		Cancer k			Peck	D. G. dust
Es ly	I C		C k			I. q. er	M S sau
Es ly	I B		G l				Perkins S
Es ly	S R					H. an	J. nec C. r
Es ly	M P		C ne				F h
Es ly	Es W		C			Roberts	Fid h A
Es ly	Mrs W		C ne				
Es ly	J. W		C k			I. nec I	Fid h Ave
Es ly	M C		A. mixed pec m				P. nec
Es ly	Mrs R		Cancer k				
Es ly	M B		Gastric test			Paul	N. S. A



TABLE I—DATA REGARDING SPECIMENS EXAMINED—Continued

Case No	Date	Name	Questionable lesions	Diagnosis	Pathological material		Surgeon	Hospital
					Gross	Microscopic		
43	1-8-30	Mr R		Cyp ulcer	*	*	Bancroft	Fifth Ave
44	1-9-30	Mr G		Ulcer		*		Univ of Minn
45	3-19-30	Mr S		Anatomical specimen	*	*		Fifth Ave
46	4-3-30	Mrs R	?	?	*	*	Hill	Fifth Ave
47	4-7-30	Mr V		Gastric ulcer	*	*		Fifth Ave
48	5-21-30	Mr F		Gastritis	*	*	Ramsdall	White Plains
49	5-20-30	Mrs C		Cancer	*	*	Bancroft	Fifth Ave.
50	10-4-30	Mr C	2 Sects IV-V	?	*	*	Bancroft	Fifth Ave
51	11- -30	Mr C		Cancer	*	*		Y G H
52	12- -30	Mr W	? Sect VI	?	*	*	Russell	Harbor
53	12-1-30	Mr S		Anatomical specimen	*	*		Fifth Ave
54	- -31	Mrs R.		Cancer	*		Bancroft	Fifth Ave
55	2-4-31	Mrs L		Granuloma colon	*		Bancroft	Fifth Ave
56	3-17-31	Mr C		Cancer	*	*		Fifth Ave
57	3-25-31	Mrs L		Ulcer cap		*	Stetton	Lenox Hill
58	4-4-31	Mr H		Hypertrophic gastritis	*	*	Bishop	Fifth Ave
59	4-10-31	Mr G		Gastric ulcer				
60	4-10-31	Mr W		Cancer	*	*	Bancroft	Fifth Ave
61	4-21-31	Mr R		Gastric ulcer		*	Lowry	Beekman St
62	6-13-31	Mr B	? Sect III	?	*	*	Roberts	Fifth Ave
63	7-9-31	Mrs C		Cancer colon	*	*		Fifth Ave
64	8-12-31	Mr M		Cancer	*	*	Falk	French
65	12- -31	Mr P		Cancer	*	*	Jonesoff	French
66	-32	Mr C	?	?		*		Univ of Minn
67	-32	U K.		Gastric ulcer		*		Univ of Minn
68	1- -32	Mrs W		Cancer colon	*	*	Have	Doctors
69	1-23-32	Mr L		Cancer	*	*	Falk	French
70	1-26-32	Mr G		Cancer	*	*	Roberts	Fifth Ave
71	2-25-32	Mr T		Gastritis		*	Herman	Asbury Park
72	2-26-32	Mr LaV		Cancer		*	Bancroft	Fifth Ave
73	3-3-32	Mr M		Gastric ulcer		*	Bancroft	Fifth Ave
74	3-15-32	Mr W		Anatomical specimen		*	Bancroft	Fifth Ave.
75	6-1-32	M		Ulcer	*	*	Edgerton	St Francis
76	9-23-32	Dr S	? Sect I	?	*	*	Erdmann	
77	10- -32	F		Ulcer	*	*	Lowry	Beekman St
78	12-19-32	Dr S		Myoma	*	*	Berg	Mt. Sinai
79	2-1-33	K						
80	3- -33	Mr S		Cancer		*	Sweet	Peekskill
81	5-8-33	Mr C				*	Edgerton	St Francis
82	6- -33	U K.				*		Akron City
83	6-26-33	Mr H		Ulcer		*	Edgerton	St. Francis
84	8-28-33	Mr B	?	?	*	*	Falk	French
85	11-16-34	F			*	*		New Rochelle
86	6-4-35	Mr M			*	*	Knap	French
87	11-1-35	Mrs J		Colon carcinoma	*	*	German	Boston

TABLE II—SUMMARY OF PATHOLOGICAL REPORTS BY 24 PATHOLOGISTS

Case No.	M i g t			Type (les)		F ber Time
	%	Yes	?	Sarc ma	Equiocal tw	
I	5	6		6		Died i m bs
II				9	5	Ab d ill al nars—in p f out of 4 reports f malignancy
III		3		6	7	Al d well after 6 years
IV		9			(Ch ages t ward cano )	Al ster 4 years—then lost track 1
V					(F e-cancerous)	P tent di d b t p b hly eoplast after per ton
VI						P ts t died (ter per n. Gen al adit bon of bmaeosa—t or th ne times as thick as normal
VII	4					Al ster 7 years—no gastric symptoms be some cardiac ascu ch nges
VIII				6	L S L.B	

PAT E. KLEIMER. Non-mal g nt—n carci mat us ul —  
 chrou C m —Th poss bility f yphal t m g  
 bro thu k ung f bma cosa and pers scular lymph d al  
 trat ns ther ugg t t  
 R t n A mal g t—ul —chr nuc with hyperplasti  
 lymph f ill d Criteria—Base f ulcer bow typ cal chr nuc  
 inflamm tory ca ti At th marg f th lc th a  
 m f lymph d t S m f th lymphocytes larger  
 tha rmal b t bel thu d t th Bect f th d t  
 ulce d not eopla ti natur  
 Czo f Non-mal g nt—not mpl l Criteri —(A) B  
 ca se of r m fib is f w l with t ca ti nd th  
 t mpt d t tru tuo f th m scular (B) pecu li lym  
 ph d mlt t n  
 A LMA N Non-mal g t—chr c kee eopla t  
 type C m —(A) N tw l gh ta edf t dy f clear  
 d tails (B) po tu d arr ng m f cells t like that f  
 plasm (C) cal th pp right m f ect might  
 tt t t t Cell he are t eoplasti lla b t gastr  
 p th lum and ng d tegrat hanges w th mlt t  
 inflamm tory li  
 McW Non-mal g nt—f inflamm tory p b bly yph  
 b C m —N t g  
 KLEIMPERE Non-mal g t—pse dol cema le cem a  
 C m —D sin te di gnosi impossible  
 ASCHRE Non-mal g t—l tu f lymph m t le-  
 Criteri —R q ested blood p ture.

## MALI ANT

E T G Mal g nt—c ci oma, small cell. Criteri —Diffuse  
 f th small typ cal polyb dral lls  
 Foo Mal gnant car ma—diff se, t th r m f lecr  
 ca hol th se ti Criteri —(A) An plast type bro-  
 m to ellis, th um mut t figures h ng loosey an  
 i col tr m (B) mght be t rpreted as lymphosarcoma,  
 b t pecal t ld dec de point (C) t ptea t be p  
 thelial th th lymphocy t  
 B Mal g nt—carci m Criteri —(A) G p ng  
 f cells (B) ellis typ cal (C) moducts f t ng (D) atyp  
 cal d  
 STE AR Mal g nt—very malig n t ca ci m sold  
 Criteri —(A) l E p l m ll polybedral cell too  
 d ll set be eco cilabl th t culum cells f lympho d t sse  
 p se t (B) ne tw l th k f s dm  
 GRAY Mal gna t—ad nocarci m Criteri —(A) T d ucy  
 t d gla d rmatio ery naplasti f thel lgr th  
 (B) E th m ll doe t ad ter ail b t m d  
 d b m l th ch act ca and pot traily m  
 malig n t tha Case IV (C) gro th unt and d by ext  
 lymph d ultrat  
 RHEA Mal gnant—ulc sec dary malig n cy t m  
 n. Sec poo C reri —t t g t n k chr nuc w th, t  
 margi diff se m ll cell type f carci ma (questi nabl  
 sarcoma) Chr ni f th ular gastritis.

FRITCHARD Mal g nt—f imposed po chr ni ulcer  
 Chroni to gastro lcer Criteri —At margi dif  
 fuse small cell d m h sed cell type ar f l m t  
 Th l ch f l l g int  
 B o e Mal gnant—sa coma (lympho) C reri —Associated  
 w th odiammat ry l  
 GUSCHT RE Mal gnant—sa coma (lympho ectic cell)  
 C reri —(A) Und rm p luf t f cells th larg d  
 (B) d fmat motot c fig (C) typ al small clea and larg  
 cyt plasm  
 B L L Mal g nt—lymph ar om t msa. Criteri —  
 N t g  
 M LLO Mal g nt—ulcer—t d fse ti lympho-  
 bl t m C reri —N t g  
 P RE Mal g nt—ul cr—t ne end fse t lympho-  
 blastoma. Criteri —Not g n

An analysis of the pathological findings in this case gives one food for thought. Of the twenty four opinions twelve were for and twelve against malignancy. Of the twelve who considered it malignant six believed it to be carcinoma and six sarcoma or some other neoplasm. Of the four who considered the lesion lymphoblastoma or lymphosarcoma two classified it as malignant and two classed it as non malignant.

If we now go back and apply these facts to the clinical aspect of this patient who presented himself for an x ray examination one year before and then had another just prior to the operation these facts become of practical significance. The patient having a clinical history that did not aid in the diagnosis and two equivocal x ray diagnoses one for and one against malignancy found himself compelled to submit to an exploratory laparotomy in order really to determine the diagnosis. At the time of the exploratory operation the surgical findings indicated beyond any question of doubt that the lesion

TABLE III—SUMMARY OF CLINICAL, ROENTGENOLOGICAL, SURGICAL, AND PRIMARY PATHOLOGICAL DIAGNOSES

Case	Clinical diagnosis	X ray diagnosis	Surgical findings	Primary pathological diagnosis	Follow up
Dr S, I	Gall bladder disease	Gastric carcinoma	Dr Erdmann—pyloric induration	Duodenal ulcer—no cancer	Died in 14 months
M W, II	Ulcer	Large ulcer—probably malignant	Dr Blank—large ulcer	Sarcoma	Alive and well after 12 years
G B, III	Cancer	Tumor mass—probably cancer	Dr Kingsley Roberts—spherical tumor	Atypical carcinoma	Alive and well after 6 years
Mr C, IV	Ulcer	Carcinoma	Dr Bancroft—peculiar soft tumor	Chronic ulcer	Alive last we knew after 4 years
Mr C V—same as IV	Ulcer	Carcinoma	Dr Bancroft—peculiar soft tumor	Chronic ulcer	Alive last we knew after 4 years
A W, VI	Ulcer	Multiple ulcers	Ulcer	Multiple ulcers	Died after operation
Mrs D, VII	Ulcer	Unusual ulcer	Ulcer	Ulcer	Died after operation
P S, VIII	Equivocal	Probably cancer—1925 probably not cancer—1926	Dr Pool—cancer	Ulcer 3-15-26 Lymphosarcoma 3-29-26 (after Ewing had reported it such) later Ewing called it carcinoma	Alive and well and free of gastric symptoms after 7 years (Heart and hypertension)

In Cases I and IV the x ray diagnosis was shown to be wrong by the primary pathological report, but was shown to be right by the vast majority of pathological opinions or by Father Time.  
 In Cases II, III, VII and VIII where the x ray report was equivocal and where one might hope and expect to depend on the pathological report for aid in the final diagnosis the combined evidence as derived from the primary pathological report, the overwhelming consensus of opinion of all 14 pathologists or Father Time, still left the final diagnosis as equivocal as the day the x ray diagnoses were made.  
 Case VI is most important of all. There was an unanimity of clinical, roentgenological, surgical and pathological opinion that this lesion was a simple ulcer. Yet this case is to be used for the foundation on which to build the unorthodox microscopic criteria of neoplasms which I hope will be accepted for publication in this Journal.

was cancer and I believe the term "carcinoma" was used. The primary pathological yardstick based on a paraffin prepared section indicated that the surgical diagnosis was wrong. This time the fight was between the surgeon and pathologist. The "x-ray man" sat on the sideline and cheered. This report did not substantiate or disprove the roentgen diagnosis because we had an equivocal one each way and with the pathologists throughout the country equally divided, both as to malignancy and the type of lesion, the main question which Pool brought up—whether or not I was becoming senile because of my unwillingness to make a positive or negative diagnosis of malignancy—still remains unsolved.

I asked Ewing to sponsor this communication, and in his characteristic "to the point" way, he said, "No, you can use my data but you have nothing to add to the diagnosis of cancer. You are simply diagnosing the pathologists."

It is not the intent of this article to diagnose the pathologists' ability. On the contrary, my desire is to find a firm foundation on which someone can build a microscopic diagnosis of cancer out of stones that are

acceptable to the majority of them. The fact that I had nothing to add to the diagnosis is, so far as Ewing knew then, true, particularly as it concerns this article. But this article does pave the way for one which does have something to do with the microscopic diagnosis of gastric lesions. I hope there may be interest enough in this article so that the second may be published at an early date.

Eleven of the pathologists who had seen these sections met at my office in May, 1933, for the purpose of reviewing the sections and defending their diagnoses. They even brought their own microscopes and discussed the great variances in opinions. Nearly 3 years later, after I had made a more intensive study of these 8 sections, a group of representative internists and surgeons met on January 29, 1936, to discuss the significance of the great divergence of pathological opinion as it applied to the problems of gastric cancer and ulcer such problems as the accuracy of diagnosis, prognosis, indications for further extensive surgery, indications for radiotherapy, and particularly the consideration of the accuracy of the pathological report in determining whether some particular lesion in which a brilliant surgical or radiation cure was

# SURGERY, GYNECOLOGY AND OBSTETRICS

accomplished was or was not a cancer whether it was a malignant neoplasm and also to discuss whether all of these terms mean the same thing

There are a variety of reasons for this incomprehensible difference of opinion They are as follows

## REASONS FOR DIFFERENCE OF OPINION

1 Different pathologists observe different microscopic findings when examining the same sections

2 Even when they observe the same findings some believe that they indicate malignancy others non malignancy

3 Some pathologists base their opinion on a general impression It is like some other lesion they have seen before Others record and analyze their findings and can tell why they think it is malignant and why it is carcinoma rather than sarcoma

4 Haste in examining the section The lack of care in searching for the criteria work ing late in the afternoon when one is tired leads to many of the errors in pathological diagnosis This reason is heartily endorsed by Ewing

5 Lack of unanimity in terminology leads to apparent differences of opinion which are diminished or eliminated by the use of some terminology which is understood by the different pathologists

6 Lack of agreement as to the exact meaning of certain common terms such as anaplasia hyperchromasia cytoplasm and even the term undifferentiated leads to confusion Pathologists may even accept the same definition but not apply it to specific findings in identical sections

7 Routine microscopic sections are so small that they are inadequate for a negative diagnosis of cancer They may be satisfactory for a positive diagnosis but not for a negative one And I believe that this is a very important factor in differences of opinion especially in cases in which the identical section is not seen by each pathologist

8 Single stains are inadequate A hematoxylin and eosin stain is excellent for cytology but eminently unsatisfactory for studying architectural changes in the lesion

## SUMMARY AND CONCLUSIONS

A In about one quarter of the cases of gastric lesions there was a difference of opinion among representative pathologists as to whether the lesion was malignant and a still greater diversity of opinion as to whether the lesion was a carcinoma a sarcoma or some other neoplasm

B Opinions vary even more when they are based on a study of microscopic sections that are cut and stained in a routine manner especially when only a single stain is used

C Ewing believes that the difference of opinion occurs in about 20 per cent of the cases

D Routine microscopic sections as cut and stained in more than 90 per cent of the institutions are inadequate to rule out the presence of a gastric cancer or neoplasm, a positive diagnosis of cancer may be made on such sections but not a negative diagnosis

E The pathologists mentioned rate above the average and if there is as much diversity of opinion among them as herein shown there would be an even greater difference of opinion among those less experienced

F This difference of opinion as to the pathology present in gastric lesions astonishes the internist and the surgeon and some pathologists but why should it?

G A similar difference of opinion as to pathology in bone tumors has been known to exist since Codman started the bone sarcoma registry

H Ewing now maintains that the pathologist encounters the same difficulty in the diagnosis of gastric lesions that he is known to have encountered in the diagnosis of bone lesions

## THE EFFECT OF THIS DIFFERENCE OF OPINION ON SURGICAL STATISTICS

Statistics as to surgical cures in gastric cancer cases and statistics on simple gastric ulcers that have become malignant should not be based on a single pathological report More over in cases in which a long surgical cure of gastric cancer is reported a critical review of the section should be made by a group of pathologists such as these but even then where does it get one in determining the ac

curacy of statistics, especially if one bears in mind sections 2, 3, 6, and 8 Should Drs Blank, Roberts, Bancroft, and Pool receive credit for surgical cures on these cases? I am not saying whether they should or should not, I am just asking the question Is the pathological yardstick a sufficiently accurate instrument with which to measure the errors in clinical, roentgenological, and surgical diagnoses? May not the clinician, roentgenologist, or surgeon question the pathological diagnosis when it is definitely at variance with their findings?

Bearing in mind the findings herein reported, it is doubtful if pathology can be used as such a yardstick In these 8 cases the pathologists found no clear cut line between those which are malignant and those which are not malignant Ewing says there is no clear cut line between a lesion which is a cancer and one which is not a cancer One finds all gradations of change in the mucosa from atropic gastritis through hypertrophic gastritis, precarcinomatous changes, undifferentiated cells, up to the differentiated group of cancer cells in which there is little or no question as to the pathological diagnosis Ewing defends the term "precancerous" as one which is necessary to describe a certain condition but he says that cases showing *only* precancerous changes cannot be claimed as surgical cures

#### NEW OBSERVATIONS AND CONSTRUCTIVE SUGGESTIONS

Ewing says that the real pathological problem is not whether a lesion is malignant or non-malignant but whether it is neoplastic or inflammatory He refers to this as a problem, something that should be solved Microscopic findings not observed or used as criteria by any of the pathologists in studying these eight sections give ample material with which to solve this problem of the differentiation of neoplastic and inflammatory lesions This is particularly true when the findings are compared with the simple "garden variety" of gastric ulcers

Case VI which was considered a simple ulcer by 22 of 23 pathologists is one which suddenly and violently attracted my atten-

tion to this subject in the last week of December, 1930, and even at that time I showed it to Ewing as an unusual case but it did not attract his attention Of the 23 pathologists who saw this case Masson was the only one who believed it to be malignant and he considered it a linitis plastica Later Ewing in reviewing this considered it possibly precancerous Everyone else considered it a simple gastric ulcer

After having intensely studied the microscopic findings of the common garden variety of gastric ulcer, the moment I saw this section it was evident to me that it was not a common garden variety and therefore even then we, my associates and myself, referred to it in our own conversation as the "hot-house variety" of ulcer in contradistinction to the "common garden variety" of ulcer with which we were familiar When I first saw this section I was completely at sea as to drawing conclusions from the findings observed in it, and made the following entry in my diary concerning it

"Friday, Jan 23, 1931

Just received 48 excellent sections of the three ulcers of A W A brief look at these confirms my suspicion of the gross specimen, viz, that this is not the garden variety of ulcer I fear these findings will completely disrupt the picture puzzle of gastric ulcers which, up to the present, has progressed so favorably Each piece of the jig-saw interlocked accurately I can't see how these findings will fit into the picture of the thrombotic pathogenesis or even of a lesion beginning with the outer coats and breaking through Or, if the sections prove to be malignant, the lesion is of such an infinitesimal size that it does not correspond with my previous conception of fair size area of malignancy that has ulcerated in its center My architect, Mr Bevin, said that some famous architect had said that a problem should be converted into a feature Applied to this problem I certainly am wondering about converting these sections of A W into a feature"

It was not until I observed another similar lesion from which four or five sections were cut that I began to comprehend the significance of the findings observed in section No 6 These two sections, Nos 4 and 5, from another lesion became the key that unlocked the problem of differentiation of neoplastic from inflammatory lesions and when the findings observed in these 2 cases are compared with those of 6 other sections, the problem of

the diversity of opinion in these 8 sections is greatly simplified

Section No. 4 has more than 50 points that differentiate it from the findings observed in the simple common garden variety of ulcer that is there are 5 findings in this section that are the direct antithesis of 25 findings observed in the common garden variety of ulcer. I believe that I am correct when I state that not a single one of the 25 criteria was recorded in the reports of the criteria of any one of the 24 pathologists. Each one of these 25 criteria is of such great significance that a definite conclusion can be drawn from it. Whether such conclusions are rational or irrational time only will tell. I am hoping that this presentation will attract sufficient

interest so that these 25 points of differentiation of new growing tissue (I shall avoid the term neoplastic) from inflammatory lesions may be accepted by this journal for early publication.

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# THE PREVENTION OF POSTOPERATIVE JEJUNAL ULCERS BY DIET AND FUNDUSECTOMY

## AN EXPERIMENTAL STUDY IN DOGS

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IN a previous study (11) the value of certain medical procedures for the prevention of jejunal ulcers in dogs operated upon by the Mann-Williamson technique was determined. During the course of these studies our attention was attracted to the report of Connell (1, 2, 3), who suggested fundusectomy as a method for decreasing gastric secretion. Having, previous to the report of Connell, performed subtotal gastrectomy (4) in a series of dogs in which at least two-thirds of the stomach was removed and in which gastric acidity returned to normal in from 3 to 5 months, we thought that fundusectomy might delay, but not prevent, the development of jejunal ulcer. However, we have found that the administration of a nutritious, easily digested diet plus fundusectomy has prevented jejunal ulcer from occurring in all of 13 dogs, 6 of which have survived more than 2 years after operation.

It should be pointed out that the experimental ulcer which occurs after the Mann-Williamson operation (gastrojejunostomy and drainage of bile and pancreatic juice into the last 15 centimeters of the ileum) is believed to be quite analogous etiologically to postoperative jejunal ulcer in man. In the course of our previous studies (11), it was found that the majority of these animals secrete a gastric juice of "normal" average acidity, but continue to secrete in response to a meal for a longer period of time than normal animals, which confirmed the report of McCann. Thus, we have in these animals a gastric juice of normal acidity coming into contact with the more susceptible (more susceptible to acid irritation than the duodenal, ref 5) jejunal mucosa for a comparably longer period of time (due to retention, hypersecretion, or both) in addition to the fact that the neutralizing and diluting action of pancreatic juice and bile is absent. From our studies and those

of others (7, 8, 9, 10), it would appear that acid irritation is the chief factor in the etiology of the ulcer. Yet, we believe that nutritional and mechanical factors, particularly the former, play an important adjunctive rôle in the rate of onset and of lethal hemorrhage or perforation. The results that follow show clearly the rôle that nutrition plays.

## METHODS

In any therapeutic study an adequate control series is essential for a trustworthy interpretation of the results. In our previous therapeutic study (11) a series of 42 control animals served as a basis for the interpretation of the therapeutic results. This control series may also be used for this study. Referring to Figure 1, curve A represents the survival-time curve for the 42 control dogs. For example, all had died with ulcer at 17 weeks, 50 per cent at 11 weeks. Curve B represents the time of diagnosis of ulcer in 22 of the dogs, the diagnosis being made by observing the presence of "tarry stools" or gross blood in the gastric contents.

In performing the fundusectomy, a wedge-shaped portion of the fundus was removed by the incisions indicated in Figure 2. This resulted in the removal of at least two-thirds and frequently three-fourths of the acid-secreting mucosa, the variation in the amount removed being due to differences in facility of exposure of the stomach. The fundusectomy was performed 3 or 4 weeks prior to the Mann-Williamson operation.

Four groups of experiments were performed. Group I. In the first group fundusectomy was performed and then the Mann-Williamson (7) operation, after which the animals were placed on the stock diet (ground parboiled meat, bread, and milk) plus raw pancreas (200 grams daily). Group II. These animals in Group I being deprived, for the larger part, of

TABLE II—EFFECT OF THE SPECIAL DIET ON  
THE OCCURRENCE OF JEJUNAL ULCER

THE OCCURRENCE OF ULCERS					Remarks
Dog No.	Days after removal of me. wounds	Presence of ulcer	Weight lost per cent		
Group 1	0	No	35		D. emper gastro-enteritis
2-6		No	35		D. emper-ulcer no
3-5	0	None	35		Obstruction—intra abdominal hernia
4		Ulcer	5		Pneumo u.—anemia—cachexia
5		None	5		Pneumo u.—cachexia
6-7		None	5		Epidermo u. h. lita
7-8		Ulcer	5		Hemorrhage
8-6	1	No	5		Obstruction—intra abdominal hernia
9-9	5	No			Cachexia—pneumo
10-9	6	Ulcer	5		H. morrhage
Group 2	20	Ulcer			H. morrhage
1-2	5	Ulcer	Gained		Perforation—normal wt lost 10% b
3	4	Ulcer	Gained		F. l. ulc. ulcer large and in-
4		Ulcer	ch. age		De. loped liver as well placed on meso-ulcer healed
5-6	4	Non	Gained		Anastomized liver 3 ribs—no
6-	6	Ulcer			H. morrhage—lost wt 1/2 a. develops ing ulcer
7-	3	Ulcer	5		Hem. bags and cachexia—1/2 wt of a. weight loss occurred at 1/2 b morrhage star ed
8-	3	Ulcer	ch. ag		Pest. mo. liver very lar and undurated
9-3	3	Ulcer	Gai. d		De. loped liver 3 weeks morrhage placed mo. killed liver healed
10-	3	Ulcer	Sl. ly lost wt. last mo		Perfor on—ulcer large and in-

Like develop d and healed gastr. muc. therapy

After CO

ulcer in Mann-Williamson dogs. After considerable preliminary experimentation with diets the following diet was chosen as the one to be used in our experiments

**SPECIAL DIET**  
High in nuclear substances vitamins and  
readily assimilable carbohydrates





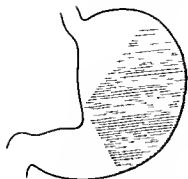


Fig. 2 Shaded area shows approximately the amount of fundus removed.

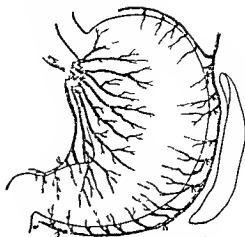


Fig. 3 Shows the vessels ligated.

years. However the average free acidity of the 6 dogs at 4 hours was 20 per cent less than the control free acidity which is insufficient in view of the variations in gastric acidity to warrant emphasis. Of greater significance we believe is the fact that the average volume of the gastric contents at 4 hours after meals was 68 cubic centimeters while in 7 Mann-Williamson dogs not fundusectomized but fed the same diet and test meal the average 4 hour post cibus volume was about 130 cubic centimeters. This marked dilution of the gastric contents at 4 hours is the most constant and striking finding resulting from gastric analysis in Mann-Williamson dogs that we have observed. In view of the acid values this fact is not easy to interpret and would merit interpretation only provided we had data on the neutral chlorides which assay was not made. When the total gastric contents obtained by aspiration at 4, 6 and 8 hours in the 6 fundusectomized dogs is summed up and averaged the results are 68, 40 and 6 cubic centimeters which is in contrast to 146, 336 and 88 cubic centimeters for 6 non fundusectomized (Mann-Williamson) dogs. This shows that the fundusectomized dogs either do not form as much gastric secretion as or show less retention than ordinary Mann-Williamson dogs that is gastric contents of about normal acidity is emptied for a shorter period of time into the jejunum of fundusectomized dogs than into the jejunum of non fundusectomized Mann-Williamson dogs.

To examine these observations further we determined the response of 5 2 year fundusectomized animals and of 5 non fundusectomized Mann-Williamson dogs to histamine. This was done by emptying the stomach then injecting 1 milligram of histamine (ergamine acid phosphate) subcutaneously and evacuating the stomach at 10 minute intervals for 1 hour. The results shown in Table IV indicate that the fundusectomized Mann-Williamson animals respond almost normally to histamine but definitely less than the non fundusectomized Mann-Williamson. This would appear to constitute very clear evidence of an increased volume of secretion in non fundusectomized dogs as compared with fundusectomized. But the evidence is not as clear as it might be because the non fundusectomized dogs have an ulcer and the fundusectomized do not and when the histamine test was applied to non fundusectomized Mann-Williamson animals during the first 3 to 5 weeks after operation when no ulcer is present we obtained only a slight increase in the volume of juice secreted in response to histamine over that secreted by normal dogs. Unfortunately we could not settle the matter on a larger series because the advisability of performing the histamine test did not occur to us until this work was practically completed. Thus we do not know whether the increased response to histamine is due to the ulcer or not.

TABLE III—EFFECT OF FUNDUSECTOMY PLUS THE SPECIAL DIET ON THE OCCURRENCE OF JEJUNAL ULCER

Dog No	Duration after operation	Presence of ulcer	Weight loss per cent	Remarks
1	57 wks	None	Gained	Pneumonia
2	8 wks	None	No change	Obstruction
3	2 yrs. 3 mo	None	Gained	Chloroformed—condition excellent
4	2 yrs 1 mo	None	Gained	Chloroformed—condition excellent
5	2 yrs 2 mo	None	Gained	Chloroformed—condition excellent
6	2 yrs 1 mo	None	Gained	Chloroformed—condition excellent
7	15 wks	None	33	Cachexia
8	1 yr 3 mo	None	No change	Pneumonia
9	2 yr 2 mo	None	No change	Chloroformed
10	45 wks	None	29	Not ascertainable
11	17 wks	None	No change	Pneumonia
12	33 wks	None	30	Gastro enteritis ( )
13	2 yrs	None	No change	Chloroformed at 2 yrs

Another factor which has been borne in mind in interpreting the foregoing results is the factor of retention, which is beyond control in such studies. Yet, it is clear that the acid factor is operating over a longer period of time in the non-fundusectomized animals, if not in a greater quantity.

In this connection, attention should be called to the occasional occurrence of jejunal or marginal ulcer in a human patient with a rapid emptying stomach following gastro-jejunostomy or subtotal resection. In most such patients gastric analysis shows either relatively little secretion of acid, or that it is difficult to obtain. From animal studies we know that distention of the intestine usually inhibits gastric secretion, but if the intestine has compensated for or adapted itself to the inhibitory distention factor, the intestinal phase of gastric secretion may become evident. In such an instance no food being present in the stomach, uncombined acid or "raw" gastric juice will pass into jejunum to irritate it and predispose to ulcer.

At autopsy 5 of the 6 animals (no ulcer present) manifested to a more or less extent the peculiar tubular form of the pyloric antrum shown in Figure 4. The interpretation

TABLE IV—THE RESPONSE OF THE NORMAL, FUNDUSECTOMIZED (2 yr) AND NON-FUNDUSECTOMIZED MANN-WILLIAMSON (4 mo) DOG'S STOMACH TO HISTAMINE

Operation	Dog No	Volume c cm 1 hr	Acidity		Remarks
			Free per cent	Total per cent	
Normal	1	40	0.118	0.200	No ulcer
	2	640	0.215	0.04	
	3	70	0.127	0.191	
	4	450	0.15	0.346	
Average		53	0.170	0.250	
Fundusectomized Mann-Williamson operation	1	330	0.115	0.130	No ulcer
	2	164	0.118	0.237	
	3	600	0.115	0.115	
	4	778	0.130	0.228	
	5	205	0.082	0.091	
Average		507	0.114	0.167	
Non fundusectomized Mann William-on operation	1	2150	0.273	0.300	Has ulcer
	2	1260	0.28	0.30	Has ulcer
	3	1350	0.200	0.410	Has ulcer
	4	1070	0.209	0.319	Has ulcer
	5	770	0.173	0.509	Ulcer questionable
Average		1320	0.216	0.350	

of this finding is not clear. In addition, 4 of the 6 animals showed the presence of a chocolate brown pigmentation of the intestine involving the musculature, but not the mucosa. The colon was likewise pigmented in 4 of the 6. This was noted by Mann and Graham in their gastrectomized dogs, but we have never seen it in our gastrectomized animals. The histology of the phenomenon is being studied by Dr. L. B. Arey.

*Group IV The effect of ligating a portion of the blood supply of the stomach on the occurrence of jejunal ulcer.* Since the secretion of any secretory organ is related to its blood supply, we decided to try the effect of ligating some of the major vessels which supply the fundus of the stomach instead of performing a fundusectomy. This procedure has the merit that it is a simple operation, but has the very definite disadvantage of being a less quantitative procedure.

In 11 animals the blood vessels shown in Figure 3 were ligated and a Mann-Williamson



Fig 4. The ph tgr ph sh the pcul tub l form f the pyl c trum berv d s f the 6 f d c t m d m l s living m r th year 1 D ph gm the card a th t l e after f nd s et m y 3 the hyp t phied segm t b j net a f hyp trophied seg m nt th the tub l pyl c trum 3 the pyl n a trum 5 th j j m w the d to s de anast m f pyl l c trum t it Th pecim w s lcted also t demonstrate the st m ch th t sh d the most adh s t b g n t d th t the hyp tr phied port on f f om dnc

operation performed the special diet described being fed. The results are shown in Table V. The development of the ulcer was definitely delayed in one (dog 7) and prevented from developing for 18 months in 3 (dogs 1, 2 and 4). In the 3 latter animals the stomach on being analyzed by a test meal and histamine reacted at 18 months just as if two thirds or three fourths of the fundus had been removed. It is obvious from the results however that the procedure is not as uniformly effective as fundusctomy as might have been predicted.

#### DISCUSSION

The literature on the effect of subtotal fundusctomy has been reviewed by Seely and Tollinger. The results are practically unanimous in showing that after 6 to 8 months the free and total acidity returns to almost normal average values. This is to be anticipated in view of the remarkable property of the stomach to undergo dilation and hypertrophy so that as long as any acid forming cells are left in place it is simply a matter of time until normal acid values are observed. Yet the mere titration of the acidity of the gastric

TABLE V.—EFFECT OF LIGATING GASTRIC BLOOD VESSELS PLUS THE SPECIAL DIET ON THE OCCURRENCE OF JEJUNAL ULCER

Dog	Diet	Acid	Weight	Remarks
1	5 m ka	N	Ga ned 6 lbs	At 6 m ka ac t h m Chl of m d no ulc al mal
2	5 m h	N	G d 7 lbs	At 6 m ka ac t h m Chl of m d no ulc al mal
3	7 w ka	Ulcer	N no	P lous ed ulcer pe onito
4	8 m b	N	G ed 6 lbs	Chl f rmed—no leay
5	5 w la	N	G ed	Mye te thr mbus
6	8 eek	Ulcer	pe	P f ed ulcer
7	5 eek	Ulc	pe	P f ed le
8	eeke	U	pe	P f d le
9	eeke	Ulc	perce	P l d le
10	5 eek	Ulc	pe	P l ted ulcer
11	5 eek	Ulc	spe	P l ed le

contents does not necessarily yield a correct picture of the acid that is available for irritant the jejunum because the volume of acid secreted and the duration of time over which it is secreted or is passed into the jejunum must obviously be considered. It is in these latter respects that our 2 year fundusctomized dogs with a Mann-Williamson operation differed from the non fundusctomized. It is chiefly this reduction in quantity and particularly in the duration of contact of secretion with the jejunum plus the easily assimilable diet which explains the failure of our fundusctomized animals to develop ulcer even after 2 years. Indeed it appears that no other reasonable explanation is possible.

Of course it is possible that our animals may have developed ulcer at 2½ or 3 years. If their gastric response should have returned to that of non fundusctomized animals or if they should have started to lose weight they would certainly in our experience based on about 170 such animals develop ulcer. As we have pointed out elsewhere totally gastrectomized dogs, pigs, rats or monkeys (we have now had experience with at least 70 gastrectomized animals living for 1 to 10 years) do not develop duodenal or jejunal ulcer although some may suffer ups and downs in

their nutrition and digestive condition. However, we shall intentionally avoid commenting or expressing an opinion on the promise of fundusectomy as a surgical procedure for the control of peptic ulcer in man. The results of well controlled animal experiments provide evidence which serves to direct clinical efforts and upon which to base the interpretation of clinical results.

#### SUMMARY

1. Fundusectomy has some prophylactic value in the prevention of jejunal ulcer in dogs operated upon by the Mann-Williamson technique and fed an ordinary diet.

2. It was found that the feeding of an easily assimilable diet to non-fundusctomized Mann-Williamson animals delayed the onset of jejunal ulcer and of lethal perforation and hemorrhage.

3. The combination of the special diet and fundusectomy prevented the development of jejunal ulcer in all of 15 animals, 6 of which survived 2 years or longer. Gastric analyses revealed a gastric acidity of normal values in the animals surviving for more than 2 years, but the acid available for more prolonged irritation of the jejunum was definitely less in the fundusctomized than in the non-fundusctomized animals.

4. These experimental therapeutic results emphasize the importance of the nutritional (disturbance of digestion) and particularly the acid factors in the causation of post-operative jejunal ulcer.

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## ENDOMETRIAL HISTOLOGY AND PATHOLOGY AS REVEALED BY THE BIOPSY METHOD<sup>1</sup>

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THE modern interpretation of the cyclic changes in the endometrium dates from the work of Hirschmann and Adler in 1908. Prior to that time the efforts of students of the endometrium had generally been directed toward describing a single norm for the appearance of the endometrium between the menstrual periods. All deviations from that alleged norm were considered pathological. The classical discoveries of Hirschmann and Adler have been confirmed and extended by numerous investigators. Noteworthy among recent discussions of the subject are those by Schroeder Novak (11), Herrell and Broders and Bartelmez and Bensley (2).

Two recent advances, however, seem to us to call for a new description of the endometrial cycle. The first of these is the isolation of the hormones of the graafian follicle and corpus luteum and the demonstration that they are capable of reproducing all the phases of the normal menstrual cycle either in the castrated monkey (Hisaw) or in the castrated human female (Kaufmann, Clauberg and Neustaedter). With these observations at hand we are not forced to limit ourselves to a morphological description of the changes taking place in the endometrium but may interpret these changes in terms of physiological processes.

The second advance is the development of methods for obtaining biopsies from the endometrium by Klingler and Burch, Hoffmann, Novak, Randall and others. The older descriptions of the endometrial cycle were based upon the study of tissue obtained by autopsy, hysterectomy or curettage. Such material is subject to two disadvantages. In the first place, autopsy and hysterectomy specimens are likely to be complicated with pathological changes. In the second place, only one autopsy or hysterectomy specimen can be obtained from any patient and only a

single curettage specimen can be obtained from any one cycle. The investigator therefore was forced to arrange the various histological pictures which he obtained into a continuous record simply upon the basis of their date in the menstrual cycle. When one considers the variability in the length of various cycles even in the same woman, the difficulties of this procedure become evident. With the endometrial biopsy instrument, however, one may take numerous specimens at short intervals throughout the same cycle and accordingly may define the succession of events with a precision hitherto impossible. The present article is based upon the study of specimens from more than five hundred endometrial biopsies of which more than a hundred were treated with various special stains chiefly the stains for mucin, glycogen and the Golgi apparatus. The biopsies were secured with the punch instrument designed by Burch.

### TERMINOLOGY

Following Hirschmann and Adler, the earlier writers classified the state of the endometrium between the menses into the postmenstrual interval and premenstrual phases. This terminology persists even in the recent writings of Novak. The three-fold division, however, does not correspond to our present knowledge of the functional stages of the endometrium and the term resting stage, which has been widely used as a synonym for interval, is an unfortunate misnomer. Present-day writers accordingly have tended to divide the entire cycle into a stage of loss (comprising the first 1 or 2 days of bleeding), a stage of re-epithelization (the following 2 days), a proliferative or pre-ovulatory stage (lasting about 10 to 12 days) and a secretory or post-ovulatory stage (lasting 1 to 14 days). The words proliferative and secretory are accurate descriptive terms and are highly satisfactory in describing the



Fig 1

Fig 2

Fig 3

Fig 1 Endometrial biopsy specimen from a normal woman, taken on the ninth day of the cycle. The picture is typical of the early follicular phase  $\times 140$

Fig 2 Specimen from the same patient as the previous figure, taken on the sixteenth day of the same cycle. The follicular effect is fully developed. Ovulation probably occurred at about this time  $\times 140$

Fig 3 Specimen taken from the same patient as shown in the previous two pictures, taken on the twenty third day of the same cycle. In this photomicrograph the luteal effects are now well developed but are still fairly early as is evidenced by the presence in some places of a clear zone between the gland nuclei and the basement membrane  $\times 140$

normal cycle. They are inadequate, however, for classifying the abnormal histological pictures which result from a deficiency or excess of follicular or corpus luteum hormone stimulation. We have accordingly given up (though not without some reluctance) the morphological terminology, and prefer to classify the histological findings in the endometrium on the basis of the phase of endocrine activity which produces them. Hence we shall use the expressions "follicular phase" and "luteal phase" in place of "proliferative" and "secretory."

#### MENSTRUATION AND RE-EPITHELIZATION

Women are wont to call any kind of vaginal bleeding "menstruation." Unfortunately, the term is also well established in medical nomenclature to designate two very different processes. The first of these, the bleeding which follows the regression of a normal corpus luteum, must be considered the normal menstruation of the human female. The second form of bleeding, which does not come from a luteal type of endometrium is often referred to as "anovulatory menstruation"

The two processes are very different both from a histological and from a physiological viewpoint, as will presently be pointed out. Though it is probably too late to change the established terminology, it is obvious that much confusion could be avoided if the term menstruation could be limited to the normal menstrual flow, and the term "follicular bleeding" could be applied to the bleeding which occurs without ovulation.

For our present detailed knowledge of the endometrial changes which occur during normal menstruation we are largely indebted to Bartelmez (1). The premenstrual congestion and leucocytic infiltration are followed by extravasation of blood into the tissues. The endometrial glands lose their secretion and collapse. Bleeding by rhexis from both arteries and veins follows, with destruction of the capillary bed. The tissue loss which results, involving the compacta and most of the spongiosa, is characteristic of normal menstruation, or as Bartelmez terms it, "menstruation following pseudopregnancy." Bartelmez believes that the extravasation, destruction of the capillary bed, and the leu-

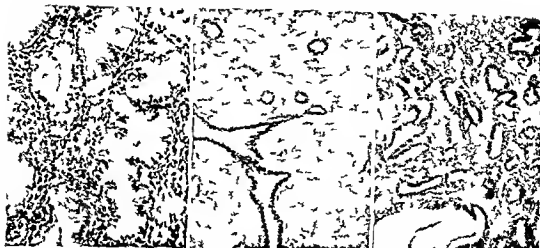


Fig 4

Fig 5

Fig 6

Fig 4. Specimen from the same patient as the previous one taken on the thirty-eighth day of the same cycle. The disappearance of the basophilic reaction indicates the cessation of the menstrual flow. The glands are small and the epithelium is thin. Magnification  $\times 140$ .

Fig 5. Biopsy specimen taken from the same patient. The patient had suffered from amenorrhea for years. The specimen is from the center of the field and is a field of the endometrium.

Fig 6. The specimen approaches the picture of normal endometrium except that the stroma is of a dense and complete aspect. Magnification  $\times 63$ .

Fig 6. Specimen from the same patient as the previous one. The patient had been suffering from amenorrhea for years. The specimen is from the center of the field and is a field of the endometrium. The glands are small and the epithelium is thin. Magnification  $\times 63$ .

cocytosis are responsible for the disintegration and shedding of tissue. Sections of the endometrium at the end of the period of tissue loss have all the appearance of sections from a freshly curetted uterus.

The stage of tissue loss is brief, lasting not more than 1 or 2 days. Before it is completed re-epithelization has already been begun by growth of the epithelium from the remaining portions of the glands. As Herrell and Broders point out, mitotic figures are infrequent during this stage of re-epithelization. The process is independent of endocrine control and will take place even if castration has been performed immediately before menstruation. At the end of this stage microscopic sections reveal a thin endometrium with infrequent small straight non-secreting glands.

#### THE FOLLICULAR (PROLIFERATIVE) PHASE

The next stage of endometrial activity is a response to the hormones secreted by the newly developing graafian follicle. Its characteristic feature is cellular proliferation which is indicated by the presence of numerous mitotic figures in the stroma and es-

pecially in the glandular epithelium. The endometrium increases in thickness and vascularity and both stromal and glandular cells increase in size. Most of the nuclei in the glands remain in contact with the base of the cells. The Golgi apparatus is seen as a conspicuous skein lying between the nucleus and the luminal end of the cell. No glycogen or mucin is present. Many of the epithelial cells are ciliated. The lumens of the glands are round and regular. The thin albuminous secretion which is present seems simply to ooze from the cells. Early in the follicular phase the stroma or interstitial tissue is very loose and is suggestive of embryonal connective tissue. Later the stroma is observed to become progressively more dense and less fibrillar. Toward the end of the follicular phase the proliferation becomes much slower, mitotic figures are fewer and the glands present a somewhat wavy form upon longitudinal section but are never definitely coiled.

#### THE LUTEAL (SECRETORY) PHASE

Very soon after ovulation the hormone of the corpus luteum (progesterone) or





Fig 7



Fig 8



Fig 9

Fig 7 Specimen of endometrium from a woman 36 years old suffering from menorrhagia. This specimen which was taken during the twenty-third day of continuous flow, shows no resemblance to the classical "Swiss cheese" picture. Rather it is essentially the same as the section shown in the previous figure from a patient suffering with amenorrhea.  $\times 57$

from menorrhagia. The specimen was taken during the thirty-fifth day of flow. We have found this typical Swiss cheese endometrium rather infrequently among our cases of endocrine menorrhagia. Such an endometrium is frequently referred to as "hyperplastic" though the cells lining the retention cysts are actually atrophic.  $\times 57$

Fig 9 Specimen of endometrium from a 20 year old girl following 3 months of amenorrhea.  $\times 57$

Fig 8 Endometrium from a 16 year old girl suffering (progesterone) begins to manifest its influence upon the endometrium. The first characteristic manifestation is the elevation of the nuclei from the bases of the cells of the glandular epithelium, producing with ordinary stains a conspicuous basal clear zone similar to that which Hisaw has observed as an early corporin effect in the monkey. This striking and specific change, like the other features of corpus luteum activity, begins at the necks of the glands and proceeds toward the deeper portions of the endometrium, but leaves the fundic ends of the glands practically unaffected. Specific stains show that the "clear zone" is filled with masses of glycogen which have pushed the nuclei up toward the lumens of the glands. Other features of the early luteal phase are a rapid reduction in the number of mitotic figures, and an enlargement and pronounced elongation of the cells lining the endometrial glands.

The glycogen masses remain basal in the epithelial cells for only about 2 days, and then begin to migrate to the luminal ends of the cells. Special stains then show the glycogen massed in club-like protrusions of the cells extending into the lumens of the glands. Ordinary routine staining methods, in which the

glycogen is dissolved out of the tissue, give the impression of a fraying of the luminal ends of the cells. The glycogen is gradually secreted into the endometrial glands. Mucin makes its appearance later than glycogen. The substance which takes the specific mucin stains is found only in the lumen of the gland and never in secretory cells. Fat globules do not normally occur in the cells or their secretion. During the period of active secretion the Golgi skeins become somewhat larger and coarser, but do not change markedly in structure or position.

The cytological changes which we have described result in a conspicuous alteration in the structure of the endometrium. Though the whole endometrium becomes thicker during the period of luteal activity, the thickening does not keep pace with the increase in the size of the glands which results from enlargement of the secreting cells and dilatation of the glands with secretion. In consequence the glands become coiled and tortuous. The enlargement of secretory cells and resultant crowding is responsible for tuft-like protrusions of the cells into the gland lumen. The lumen of such a gland exhibits on longitudinal section a typical "saw tooth" appearance.



Fig 10

Fig 11

Fig 10. Specimen of endometrium 16 days after last menstruation. Magnification  $\times 65$ .  
 Fig 11. Specimen of endometrium 6 days after last menstruation. Magnification  $\times 60$ .

Coiling of the glands is most noticeable in the middle layers of the endometrium. Here their tortuosity becomes so great that the stroma cells are crowded out and are forced up toward the surface of the endometrium. This process divides the endometrium into three distinct zones. The superficial zone (zona compacta) is composed of relatively straight glands separated by masses of stroma cells. The middle zone (zona spongiosa) is composed of many coiled glands with hardly any interstitial cells between. The deepest layer of the endometrium (zona basalis) as has been mentioned is only slightly affected by the cyclic changes.

The endometrium in the stage of fully developed luteal activity is frequently diagnosed as endometrial hyperplasia or even more unfortunately hyperplastic endometritis. It should hardly be necessary to point out that these terms are absolutely unjustified for it has been amply demonstrated ever since the work of Hirschmann and Adler that this histological picture is not pathological but is a phase of the normal endometrial cycle.

Late in the luteal phase further changes occur. The columnar cells which line the endometrial glands have now discharged

most of their glycogen and appear shrunken. The lumens of the glands become even more ragged in outline. The endometrial arterioles assume a definitely spiral shape. The stroma cells of the compacta which have been gradually increasing in size now become definitely edematous. The stroma cells have by this time entirely lost their fibrillar character and their polygonal cell walls may now be definitely seen. The interstitial tissue at this stage sometimes receives the designation decidua menstrualis. This term is unfortunate because the presence of glycogen in the stroma cells which is the characteristic feature of true decidua is not observed. Finally congestion and leucocytic infiltration herald the next menstrual period.

#### THE FUNCTIONAL PATHOLOGY OF THE ENDOMETRIUM

The endometrial biopsy punch is obviously liable to miss a small area of carcinoma if such be present in the uterus. Biopsy should never be accepted as a substitute for curettage when a neoplasm is suspected. On the other hand the minimal disturbance to the patient occasioned by the taking of an endometrial biopsy and the possibility of obtaining sev-

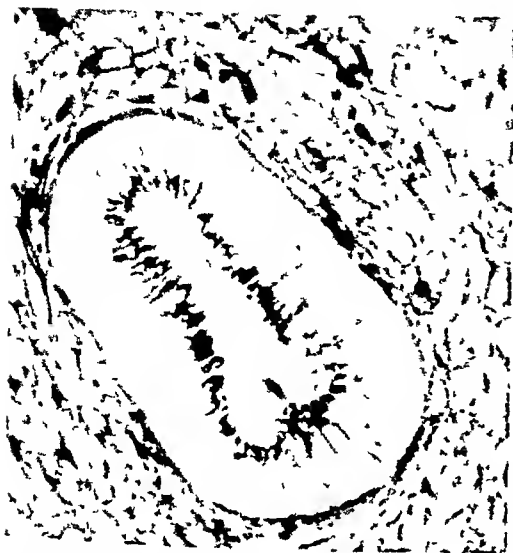


Fig. 12. Gland from endometrium in follicular phase stained to show Golgi apparatus  $\times 600$



Fig. 13. Endometrium in luteal phase, stained to show Golgi apparatus  $\times 600$

eral endometrial specimens during a single cycle, make this a very useful procedure in determining what endocrine disturbance, if any, may be the cause of such a condition as amenorrhea, menorrhagia, or sterility.

**Abnormalities of luteal function.** Maturation of a graafian follicle and ovulation are necessary antecedents to the formation of a normal corpus luteum. Accordingly, though luteinization may be disturbed while follicular development is normal, follicular function can hardly be disordered without gravely interfering with ovulation and luteinization. In the interest of simplicity, therefore, we shall invert the logical order, and shall describe first the abnormalities of luteal function and afterward the abnormalities of follicular function.

Three functional disorders of the corpus luteum have been described: (1) failure of luteinization, (2) excessively prolonged luteal activity, and (3) an abnormal secretion producing a so-called "mixed picture" in the endometrium. Failure of ovulation and of corpus luteum formation is by all odds the commonest and most important of these conditions. It is easily diagnosed by the absence of the luteal type of endometrium before an expected bleeding; this luteal reaction should

occur 4 weeks following the onset of the previous menstrual period. Excessively prolonged luteal secretion is theoretically possible with such conditions as corpus luteum cysts. Herrell and Broders have made the diagnosis of prolonged corpus luteum activity but their evidence is not conclusive. We have not been confronted with this condition. As far as we can judge from our observations, the part of the cycle with variable duration appears to be the follicular phase. Once a corpus luteum has formed it appears to run its course with great uniformity and to regress after not more than fourteen days, precipitating the next menstrual flow. Regarding the so-called "mixed picture," we are also inclined to be skeptical. A biopsy taken early in the luteal phase may show manifestations of luteal activity near the necks of the glands, and deeper in the endometrium show only glands typical of the follicular phase, but this is a normal phenomenon. Corpus luteum formation appears to us to be a very constant "all-or-none" reaction, and in case a corpus luteum is formed, it is apparently able almost invariably to override the effects of the estrogenic hormone which is normally secreted at



Fig 4

Fig 5

Fig 6

Fig 4 Specimen from rm l v man th tenth day  
f cycle h g l l cul type of d metr m X57  
Fig 5 Specimen from same pat t as pe spc  
tur tak n twe t eth day f th me cy le Early  
l teal effects. X57

Fig 6 This p c m n s f no the sam pat t as  
sh a the p phot mc graph ndw bta d  
n the twenty sex th day f th sam cycl Th spec  
m n s a good xample f the f lly d v l ped l tal  
tage X57

the same time. The question of a mixed picture has arisen only a few times in over five hundred biopsies and we have never made the diagnosis without grave doubts.

**B. Abnormalities of follicular functions.** In cases in which there is a failure of corpus luteum formation a variety of disorders of follicular secretion may also be manifested in the endometrium. The simplest case is that of castration. In this condition the endometrium is scanty, the stroma very dense and the glands small and infrequent. Mitotic figures are absent. The cells lining the glands are crowded together in such a way that the nuclei appear very narrow and spindle shaped instead of ovoid. Besides the cases of absolute castration one finds numerous cases of amenorrhea in which the level of follicular activity is reduced almost to the castrated type. In this group are included many cases of menopause and premature menopause. When follicular activity is not completely absent the endometrium is slightly thicker and the glands appear somewhat more numerous. The glands may be somewhat dilated and retention cysts may even be present.

In contrast to this well defined group including castration and inactivity approach

ing the castrated state we are confronted with a large number of cases of amenorrhea, recurrent follicular bleeding and menorrhagia in which the endometrial histology closely resembles that of the fully developed follicular phase. The three conditions cannot be distinguished from one another by any difference in their endometrial histology. In the case of recurrent follicular bleeding and menorrhagia it is interesting to observe that in contrast to normal menstruation bleeding occurs from a follicular type of endometrium and also occurs without loss of tissue. Even the bleeding points generally cannot be made out. Recurrent follicular bleeding often so closely simulates normal menstruation that it can be distinguished only by a histological examination of the endometrium. In the three clinical conditions the endometrium may differ from that of the normal follicular phase in three respects: the glands are often more irregular than normal, the lining cells may be pseudostratified and more or less dilatation of the glands is usually present. Dilatation of the endometrial glands is fairly reliable evidence that prolonged follicular stimulation has taken place without the interruption of luteal activity and normal men

struation The glandular dilatation may be found in all degrees up to the typical "Swiss cheese" endometrium We have found the fully developed Swiss cheese picture rather rarely, and in our material it has been no more characteristic of menorrhagia than of amenorrhea

The fact that amenorrhea, cyclic follicular bleeding, and menorrhagia of the endocrine type may be indistinguishable on the basis of endometrial histology is worthy of repetition The endometrial biopsy is evidently not yet an adequate substitute for a good clinical history

#### SUMMARY

It is the purpose of this paper to point out the characteristic manifestations produced in the endometrium by the follicular and corpus luteum hormones, and to recommend the examination of the endometrial histology by the biopsy method as a control for endocrine diagnosis and therapy *Up to the present time the physiological changes of the normal endometrium have not been sufficiently appreciated by the clinician or even by the clinical pathologist*

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# ACUTE SUBDURAL HEMATOMA AND ACUTE EPIDURAL HEMORRHAGE<sup>1</sup>

A STUDY OF SEVENTY TWO CASES OF HEMATOMA AND SEVENTEEN CASES OF HEMORRHAGE  
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## ACUTE SUBDURAL HEMATOMA

WE here present 72 cases of acute subdural hematoma diagnosed at either operation or postmortem examination from 4 hours to 21 days after head injury. Cases of head injury dating back longer than 3 weeks were excluded.

Virchow described this condition in 1857. He pointed out that in the insane in the chronic alcoholic and in the luetic there occurred a subdural inflammatory process which he termed pachymeningitis hemorrhagica interna. Since that time much has been learned.

Trauma is the most frequent cause of subdural hematoma usually mild in chronic cases with the development of signs or symptoms months or years later. In the acute hematoma the type under discussion however the injury is usually although not necessarily severe and the underlying brain almost never escapes damage. In the acute period unconsciousness and a bloody spinal fluid are usually present. While trauma is the most frequent cause there is no doubt that alcoholism syphilis various abnormal conditions of the blood and blood forming organs (anemia leucemia scurvy avitaminosis) and brain tumors which interfere with the dural venous drainage are predisposing factors to such an accident. In children birth trauma syphilis malnutrition scurvy and the acute exanthemas have all been described as predisposing factors. Studdiford has recently pointed out that subdural hematomas are most likely to occur in newborn infants obstetrically ill born.

In describing his four cases of chronic subdural hematoma Trotter pointed out that these lesions usually follow a slight trauma which is received in the anteroposterior diameter and that the blood which enters the subdural space is due to the rup-

ture of a cerebral vein as it bridges that space en route to the longitudinal or lateral sinuses. The underlying brain is usually undamaged. Only rarely is there an associated fracture of the skull. The acute subdural hematomas on the other hand (Vance Apfelbach Leary) are more often though rarely associated with skull fracture (usually lateral or posterior) and almost invariably associated with an underlying brain laceration and rupture of a cerebral cortical vein. Subdural hematomas may also result from a tear in one of the dural sinuses. These occur usually with fractures or penetrating wounds. Occasionally subdural bleeding follows an epidural hemorrhage in which the dura has been lacerated and epidural blood enters the subdural space. Rarely this type of hemorrhage may occur without trauma. Helpern has recently reported such a case in which a cerebral aneurism ruptured at the point where the internal carotid passes through the subdural into the subarachnoid space to continue as the left middle cerebral artery.

Once blood enters the subdural space however its further course is the same whatever the original etiology may be. The acute hematomas manifest themselves clinically at a much earlier date because there is so much associated brain damage. These lesions start as a collection of blood and cerebrospinal fluid caught in a space from which little absorption occurs. The attempt which the body makes to organize and remove this clot is the work of the dura. Within several hours after the receipt of the injury the fibrovascular layer which eventually envelops the blood has already begun to form. It is usually fairly complete in a matter of two to three weeks. As has been said by Merritt and Munro this admixture may become either a completely solid clot or a collection of cerebrospinal fluid with high pro-

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tein content. They point out that those intermediate clots possessing any especial degree of fluidity are probably expanding lesions. That they do increase in volume is evident from their clinical course. The following factors may contribute:

1. Gardner has shown that the clot having been formed and the membrane organized, that portion of the membrane adjacent to the arachnoid may act as a semi-permeable membrane through which the cerebrospinal fluid passes into the subdural space. This is an attempt to equalize the differential osmotic tension between the fluid in the subarachnoid space and the highly concentrated protein fluid (blood) in the subdural space.

2. Putnam, Zollinger, and Gross have shown that there occurs a gradual disintegration of the encysted red blood cells with the resultant liberation of hemoglobin from the cell stroma and its reduction to smaller protein aggregates. This produces a higher effective osmotic pressure. They believe that the substance added to the hematoma to increase its volume must come, at least in part, from the plasma of the circulating blood. The large dilated capillaries in the outer wall of the hematoma sac usually lie close to the lumen of the cyst. An exchange of fluids between the two is therefore probable.

3. Rupture of the dilated capillaries seen in the outer wall of the hematoma sac adds blood to its contents.

4. Repeated bleeding may come from the original source of hemorrhage.

It is probable that in most cases more than one factor exists. One type of subdural fluid collection warrants comment. In 1924 Naffziger described abnormal collections of cerebrospinal fluid in the subdural space following trauma under the name of subdural hydroma. He pointed out that since no normal connection existed between the subdural and subarachnoid spaces it was necessary to assume a tear in the arachnoid at the time of the trauma allowing cerebrospinal fluid to enter the subdural space.

#### DIAGNOSIS

Subdural hematomas follow about 9 to 13 per cent of all severe head injuries. These

figures are appalling when we realize how seldom this condition is diagnosed clinically. The diagnosis of the chronic type of subdural hematoma has been discussed often and its difficulties stated. It is usually confused with brain tumor, post-traumatic neurosis, lues, or vascular accident, and is often disclosed only at operation or at the autopsy table. Dyke has recently described in one case what he considers to be a typical encephalographic sign of chronic subdural hematoma. He was able to demonstrate a collection of air in the subdural space which appeared to be surrounding a mass and was able to make a diagnosis of subdural hematoma prior to operation. His case is, however, very unusual and of uncertain practical importance, since air injected by the lumbar route does not usually enter the subdural space unless an abnormal communication with the subarachnoid space exists. In addition, this procedure is of value only in the chronic hematoma. The "acute" subdural hematoma patients are much too ill to permit of such a diagnostic procedure. In infants the condition is usually mistaken for hydrocephalus, birth injury, brain tumor, or some congenital abnormality. Suspicion should be aroused by any infant with progressive enlargement of the head, changes in the optic fundus and signs of brain involvement (usually convulsions or hemiparesis). The diagnosis may be confirmed by puncturing the fontanel. Bloody fluid will be obtained as soon as the membranous fontanel is pierced.

The diagnosis of "acute" subdural hematoma is equally difficult. Those patients who are admitted to the hospital with a head trauma are immediately put on a dehydration regimen. The following are especially significant: (1) The *development* of focal signs usually of a hemiparetic nature or the progression of those focal signs which may already exist at the time of admission, (2) "in and out" consciousness or progressive stupor, (3) a pulse rate below 60, (4) the sign of the dilated pupil has been in our experience a very valuable localizing sign. In the event of operation, the first trephine opening should always be on the side of the dilated pupil.

The spinal fluid in these cases on admission is usually bloody although it may be xantho-

chromic or even clear. While of no value in making the definite diagnosis of subdural hematoma, lumbar puncture should be performed in these cases because the type of spinal fluid indicates roughly the prognosis of any given case of head trauma. In addition the withdrawal of spinal fluid by lumbar puncture allows an equal amount of blood to enter the cranial cavity and thereby help in the repair of injured brain tissue. This fundamental concept of brain surgery was introduced by Dr Temple Fay and is probably the most important factor in keeping his mortality rate for head injury so low.

#### THERAPY

All patients with head trauma routinely receive the following treatment until such time as it is to be decided that operative intervention be advisable:

1 Shock if present is treated with intravenous injections of hypertonic glucose solution (from 100 to 150 cubic centimeters of 50 per cent sterile dextrose). Morphine is denied and instead one of the barbitol derivatives is used.

2 Lumbar puncture is performed.

3 Hypertonic dextrose solution is administered repeatedly by vein for brain dehydration (100 cubic centimeters of 50 per cent sterile dextrose three times daily). Evidence has recently been advanced to indicate sucrose a disaccharide is a superior dehydrating agent; it is not stored but is entirely eliminated by the kidneys. We are experimenting with this drug at the present time.

4 Caffeine sodiobenzoate is given by hypodermic injection ( $7\frac{1}{2}$  grains every 4 hours).

5 By means of rectal drip from 90 to 120 cubic centimeters of 25 per cent dextrose solution is given every 4 hours.

6 The head of the bed is elevated 15 to 45 degrees.

In discussing the further therapy of subdural hematoma it must be emphasized that the only method for the removal of blood in the subdural space is its surgical evacuation. It possesses practically no capacity to rid itself of any quantity of entrapped blood. The operative approach to these lesions utilizes one

of three methods: (1) the osteoplastic flap, (2) the subtemporal decompression with associated clot removal, and (3) the bilateral trephine exploration. We greatly prefer the last method and use it in all our cases for the following reasons:

1 It saves time.

2 The operation is done under local novocain anesthesia and is much less shocking than either of the other two methods. Even though the clot be bilateral, this procedure can be carried out without damage to the patient.

3 If the clot is too solid to be removed by suction (a rare occurrence in acute subdural hematoma) the trephine opening may be used as a point for the turning down of the bone flap.

4 As will be noted in the statistical study it is often difficult to determine the side of the lesion or indeed the presence of a subdural hematoma. Trephining allows us to expose the subdural space without undue shock to the patient. In the event that these trephines result in a negative exploration, these same openings may be used for ventriculography.

It has been argued that the trephine approach to subdural hematoma results in an incomplete removal of the entrapped blood and that the blood remaining in the subdural space might act as the nucleus for the formation of another clot. Two cases which came to autopsy (from other causes) several months after the successful but non-total removal of a hematoma through an enlarged trephine opening refute this argument. In both instances there was no sign of any blood in the subdural space and no evidence of any membrane formation although at the time of operation it was known that a small amount of blood had been left in the subdural space.

#### STATISTICAL SURVEY—SEVENTY TWO CASES

Of the total number of cases reported 49 patients were seen by members of the neurological service at Bellevue Hospital with 40 accurately diagnosed. In the past year 27 patients came to our attention with accurate diagnoses in 24 cases. Of the 23 other cases studied 4 were accurately diagnosed in many; the diagnosis had not been suspected.



There were 51 males and 21 females. Sixty-eight were white people and 4 were colored.

As to contributory diseases, acute alcoholism complicated 40 of the 72 cases. Other complicating factors were generalized arteriosclerosis (5 cases), lues (2 cases), and 1 each of epilepsy, prematurity, diabetes, pregnancy, and heroin addiction.

*Nature of the trauma* In every case in which a history could be elicited trauma was the precipitating factor. The type of trauma varied from a fall during an alcoholic bout to a kick by a horse. In every instance the injury was severe.

*The time interval between trauma and symptoms* could be judged accurately in only 36 cases, in the others, patients were either in coma at the time of admission or died following operative intervention without an adequate history being obtained. In 29 there was an immediate loss of consciousness following the trauma, in the others, the time interval varied between several minutes and 15 days.

*The initial period of unconsciousness* varied from "a few seconds" to 24 hours. Those patients with an initial period of prolonged unconsciousness were much less likely to survive. In 65 of the cases reported there was an immediate loss of consciousness at the time of the accident. To what extent alcoholism contributed cannot be stated with certainty.

*The lucid interval* varied anywhere from 3 hours to 21 days. Only 3 of our cases had a lucid interval of over 15 days. It can thus be seen that we are dealing with an acute process.

As to vomiting, 37 of the 72 patients vomited at some time during their hospital stay.

Specific notes regarding headache were made in 41 cases. It was present in 36.

Ten patients had generalized convulsions under observation, 4 being of Jacksonian type. These latter, however, proved of no diagnostic aid, for on two occasions the lesion was on the side contralateral to the convulsion and on two occasions it was on the same side.

In 25 cases patients bled from nose or ears.

*Outward evidences of head trauma* were noted in 45 of the 72 cases. Ten other cases had signs of trauma elsewhere on the body.

In 40 patients incontinence of urine or feces was noted.

TABLE I — AGE INCIDENCE

Age in years	Cases
0 to 9	2
10 to 19	3
20 to 29	11
30 to 39	17
40 to 49	16
50 to 59	15
60 to 69	4
70 to 79	4
Total	72

*Pupils* In 42 of the 72 cases the pupils were unequal, in 30, the lesion was found on the side of the dilated pupil, in 12, on the side opposite the dilated pupil, in the 30 additional cases the pupils were equal at all times.

*Papilledema* The fundi were examined in 54 cases. Twenty had papilledema, 11 had engorgement of the fundal veins, in 23 cases the fundi were normal.

*Cranial nerve palsies* In the 50 cases of hemiparesis the lower facial was involved on that side. In addition there were 7 cases of third nerve paralysis and 2 of sixth nerve paralysis, otherwise the cranial nerves escaped injury. However, there are many difficulties associated with testing the cranial nerves of patients with head trauma, and the records must be examined critically.

*Motor weakness* Fifty patients showed localizing signs in the nature of a hemiparesis or a hemiplegia. In 20, the lesion was found on the side opposite this motor weakness, in 20 others, on the same side, and in 10, operation or postmortem examination revealed bilateral subdural hematomas. Fourteen patients showed generalized flaccidity, 4, generalized spasticity, and only 4 patients showed no evidence of paresis or paralysis.

These statistics indicate that at operation one should first trephine on the side of the dilated pupil since this is almost three times as accurate a localizing sign as the sidedness of the paralysis which is indeed of but doubtful assistance. However, no sign is unfailing and bilateral trephine is always needed. Ten cases had a dilated pupil and motor weakness on the opposite side. The lesion was found on the side of the dilated pupil in 7 cases.

*Sensory examination* was found to be of no aid in the diagnosis of subdural hematoma, and for that reason is not included here.

Forty two of the patients had a *stiff neck* at some time during their stay in the hospital. The earlier the patient was seen the more frequently was it possible to elicit this sign. It was always associated with blood in the spinal fluid.

The *deep reflexes* were of no help in arriving at a diagnosis.

The *superficial reflexes* showed

( ) Abdomen ls	Cases
Bilat rally bs t	53
Abse to one side	1
Bilat rally p esent	5
( ) Babinski	
Bilateral	38
U nter l	2
N o s gn	4

When the Babinski sign was bilateral it was usually more marked on the side of the motor weakness.

*Mental state on admission.* Comatose patients 46 stuporous 12 confused 5 drowsy 4 clear 5. Practically all of the patients showed the typical lapsing in and out of coma.

*Phasic studies* were made in 44 cases. 6 had aphasia, 3 in conjunction with right sided hematomas (1 of these had a laceration of the left temporal fohe) and 3 in conjunction with left sided lesions.

#### LABORATORY FINDINGS

The *white blood count* varied from 4,000 with 34 per cent polymorphonuclears to 23,000 with 88 per cent polymorphonuclears. All but 2 cases showed a polynucleosis and a leucocytosis.

The *spinal fluid* examination showed

Type fl d	Op L vert	D d	N L cel	D d
Bloody	7	4	0	6
N nthoch m	8	6	0	4
Cl a	6	0	0	
N t d n	0			9

There was a definite correlation between the type of spinal fluid and the prognosis. The patients with frankly bloody spinal fluid had the poorest prognosis and those with clear fluid recovered in every instance if they were subjected to operation. Bloody fluid usually meant brain laceration or contusion.

The *manometric pressure* readings varied from 40 to 650 millimeters of water. In most patients the spinal fluid pressure was normal.

In three instances a positive *blood Wassermann* was obtained and in one of these the *spinal fluid Wassermann* reaction was positive. We believe it to be an inconsiderable factor in producing this lesion.

As to *blood pressure* 20 patients had evidences of hypertension during their hospital stay of this number 12 died and of the 8 remaining 4 showed a postoperative return of their blood pressure to normal levels.

The *pre operative pulse rate* varied from 42 to 160. In 36 cases there was a drop of the pulse rate to below 60 at some time prior to operation or death.

*Respiration* was found to be of no diagnostic value.

*Pre-operative temperature* varied from 97 to 106.7 degrees F. Twenty patients with a temperature of above 103 degrees F were operated on of this number only 4 lived.

*Röntgenograms of the skull* were made in 17 cases. Of these only 3 showed evidences of fracture and in each instance the hematoma was on the side opposite the fracture. There was a pineal shift in only 1 case.

Only 1 patient had an *encephalogram*. This showed a shift of the ventricular system to the side opposite the lesion with obliteration of the cortical markings on the side of the lesion.

The *hematoma* was found on the right side in 32 cases, on the left side in 30 cases it was bilateral in 10 cases and in 1 case it was beneath the tentorium.

The *mortality rate* is given in the following table.

MORTALITY RATE				
Oper	Cases	Lt	Lt	per cent
N l gical serv e	3	8	14	43.3
Gen ls gctise	9		7	77.7
N pe at	3		3	100.0

*Postmortem findings.* Twenty one patients died after operation. 11 were subjected to post mortem examination. In most instances only the head was examined. Two showed evidences of fractured skull. All had extensive

brain laceration in addition to the subdural hematoma which had been fairly completely removed in all cases but 1. Of the 31 cases proved at postmortem to have subdural hematomas, examination only 5 were uncomplicated, the others were all complicated by brain laceration and intracerebral hemorrhage.<sup>1</sup> In 1 case the hematoma was found to be bilateral and beneath the tentorium. Death was rapid in this case, due probably to medullary compression.

#### SUMMARY

1 Seventy-two cases of "acute" subdural hematoma were seen at Bellevue Hospital from 1912-1936. Of these, 49 were seen by the neurological service with 40 accurately diagnosed. Of the 23 remaining, 4 were diagnosed aught. Twenty-eight were diagnosed at autopsy.

2 The neurological service operated on 32 of these patients with an operative mortality of 43.7 per cent. The general surgical service operated upon 9 of these patients with a mortality of 77.7 per cent.

3 The various signs and symptoms encountered have been discussed, and an attempt has been made to determine various pre-operative prognostic factors.

4 The treatment of subdural hemorrhage is given.

5 We have given the postmortem findings. They show why diagnosis is so difficult and operative mortality so high.

6 The following differences between "acute" subdural hematoma and epidural hemorrhage to be discussed, are here noted.

"Acute" subdural hematoma occurs at all

ages, epidural hemorrhage is more apt to occur in young adult and middle-aged individuals.

An epidural hemorrhage usually occurs on the side of the received trauma, an "acute" subdural hematoma is much more likely to be in the nature of a contrecoup phenomenon.

Epidural hemorrhages are almost invariably associated with an overlying fracture line crossing the middle meningeal groove or one of the cranial venous sinuses. "Acute" subdural hematoma is much more rarely associated with skull fracture, usually posterior or lateral in location, and usually contralateral to the hematoma.

The lucid interval in cases of epidural hemorrhage is usually of shorter duration than is that of "acute" subdural hematoma. Overlapping does occur however.

If paresis results in cases of epidural hemorrhage, it is practically always contralateral, in cases of "acute" subdural hematoma a resultant paresis is just as apt to be ipsilateral. In the latter group we have found the dilated pupil to be about three times as accurate a localizing sign as is the side of the paresis.

Epidural hemorrhage is a much less frequent complication of head trauma than is the "acute" subdural hematoma, the incidence being about 1 to 4.

"Acute" subdural hematomas are much more apt to be bilateral.

The mortality rate following operation in cases of epidural hemorrhage was 54.5 per cent, in cases of "acute" subdural hematoma, as noted above, it was 43.7 per cent.

#### ACUTE EPIDURAL HEMORRHAGE

There is a great discrepancy between the number of cases of epidural hemorrhage recognized clinically and the number remaining undiagnosed until they reach the postmortem table. In our opinion, this is due to the fact that the syndrome of epidural hemorrhage is much too rigid. The lesion is not common. In the 6 year period from 1930 to 1936 we ob-

served 17 cases of epidural hemorrhage at Bellevue Hospital. During this same period we saw four times as many cases of acute subdural hematoma. These latter cases have just been discussed.

Epidural hemorrhage complicates 2 to 5 per cent of all craniocerebral injuries. The fact that medical examiners' statistics usually yield a much higher figure is due to their seeing only autopsy material. Such postmortem records,

<sup>1</sup>Ten had skull fracture and in 8 the fracture line was contralateral to the hematoma.

however are of great value because they indicate to what extent the complicating factor of epidural hemorrhage disturbs the prognosis in any given case of head trauma.

Epidural hemorrhage usually follows a lateral skull fracture which has lacerated one of the branches of the middle meningeal artery—usually the posterior branch. The vessels may be torn by a local depressed fracture or by a crossing line of fracture. The frequent association of this type of hemorrhage with a skull fracture should not appear unusual when we realize that the middle meningeal artery lies grooved in the bone throughout its course in the skull. The temporal bone is very thin—a slight blow has sufficient force to fracture it.

The bleeding above the dura therefore is usually present on the same side as the injury although it may also be the result of a contrecoup lesion. This was true in one of our cases. It is necessary to keep this type of hemorrhage in mind no matter in what region the outward evidences of skull fracture be found.

The blood collects between the bone and dura and as bleeding continues additional branches of the middle meningeal artery are lacerated as they dip in from the bone toward the dura. This adds to the original hemorrhage and when enough blood has collected signs of compression of the underlying brain occur usually in the form of contralateral paralysis or convulsions.

These clots are usually unilateral and over the convexity of the brain although they may occur at the base over both cerebral hemispheres or over the cerebellum. They are almost always associated with some degree of underlying brain damage—a fact which is not as yet universally recognized and is vital in determining the prognosis in each case (Munro).

Epidural hemorrhage and middle meningeal hemorrhage are not synonymous terms although they usually occur together. On occasions hemorrhage above the dura may come from a tear in one of the cranial venous sinuses laceration of the anterior meningeal artery bleeding from bony fragments at the point of a depressed fracture or following the turning

down of a bone flap in which hemorrhage had not been properly controlled. Still more rarely it is the result of severe head injury in which the dura has been lacerated and collections of subdural blood have entered the epidural space.

It has been observed repeatedly that epidural hemorrhage is more likely to occur in people during the prime of life. For this circumstance Vance has given a most satisfactory reason.

In childhood the bony grooves for the middle meningeal artery are shallow and the dura is easily separated from the skull—hence the artery escapes injury except rarely. In elderly people the grooves deepen and the dura becomes adherent. Epidural clots are therefore rather infrequent since the adherent dura prevents excessive hemorrhage. In adults however the bony grooves are not so deep and the dura is sufficiently adherent to allow laceration of the artery but not to such an extent as to prevent separation from the bone by the violence.

#### DIAGNOSIS

The typical epidural hemorrhage syndrome is too well known to be repeated here suffice it to say that one seldom encounters it. But if the so called pathognomonic succession of events is noted operation should take place at once. Much has been written about the clear spinal fluid which is associated with epidural hemorrhage. However a word of warning is necessary. While it is true that there is no reason for a pure epidural clot to stain the subarachnoid fluid the associated brain damage is almost always severe enough to give a pink or bloody tap. Our general feeling about this type of bleeding is that operative intervention should be undertaken in any case of head trauma with a relapse into a clouded state of consciousness with a pulse drop to below 60 or where signs of a focal nature (hemiparesis convulsions) occur tardily or a progression of those focal signs noted on admission. If there be further corroborative evidence in the nature of a fracture line crossing the middle meningeal groove or one of the cranial venous sinuses operation is imperative. The presence of a dilated pupil should guide the surgeon to the side of the first trephine opening. By adhering to these simple principles we were able to advise operation in 15 of the 17

cases which came to our attention. Yet the diagnosis of epidural hemorrhage or "acute" subdural hematoma does not rest exclusively on these signs. Each case remains a distinct clinical problem, but an analysis of these cases proved these signs to be most helpful in arriving at a diagnosis. Intervention should consist in enlargement of the trephine opening placed midway between ear and vertex large enough to (1) remove the clot, (2) identify the bleeding point and control hemorrhage, (3) open the dura to search for associated subdural hematoma and produce a better decompression. After operation these patients should have a blood transfusion.

Epidural hemorrhages which follow the turning down of a bone flap are an infrequent occurrence. Once diagnosed their treatment is exactly the same as for any other type. Their prevention is a matter which has as yet not received sufficient attention. Poppin has recently devised an ingenious method for the turning down of a craniotomy flap in which the dura is sutured to the bone in such a manner as to make it practically impossible for epidural clots of clinical importance to form.

#### STATISTICAL SURVEY—REVIEW OF SEVENTEEN CASES

As to sex incidence, there were 14 men and 3 women.

As to age 13 of the 17 cases were in the young adult and middle-aged groups emphasized by Vance.

**Diagnosis.** Ten cases were clinically diagnosed as epidural hemorrhage. Two were diagnosed in the same way as extracerebral (epidural or subdural) hematoma. Three were diagnosed as subdural hematoma, and the epidural hemorrhage was found during the course of the exploration, 2 were not diagnosed during life but were discovered at autopsy. One patient died shortly after examination, and opinions were divided between epidural hemorrhage and tuberculous meningitis. Postmortem examination revealed a huge right epidural hemorrhage weighing 140 grams and no underlying brain involvement. This patient could probably have been saved by operation. In another case a diagnosis of a

pontine hemorrhage was made and postmortem examination confirmed this suspicion but there was an associated left epidural hemorrhage weighing about 95 grams.

**Nature of trauma.** The types of trauma varied: (1) fall, 6 patients—5 of these falls occurred in alcoholic persons, the other during an epileptic convulsion, (2) blow, 5 patients, (3) automobile accident, 2 patients, (4) operative trauma following the turning down of an osteoplastic flap, 1 patient, (5) unknown, 3 patients.

As to *contributory diseases*, alcoholism complicated the picture in 6 patients, generalized arteriosclerosis in 2, hypertensive heart disease with associated renal damage in 1, and epilepsy in another. The 4 latter patients died.

**The time between trauma and onset of symptoms** varied as follows. There was an immediate loss of consciousness in all but one. This primary period of unconsciousness varied from "a second" to 8 hours. Two patients with a prolonged period of primary unconsciousness (7 and 8 hours) died. At postmortem examination both of these patients were found to have sustained severe brain lacerations.

The *lucid interval* is usually defined as that period of relatively clear consciousness which comes between the initial unconsciousness and the final clouding of consciousness, which occurs when enough blood has accumulated between bone and dura to compress the underlying brain. Fifteen of the 17 patients had a lucid interval—this varied in time from 1 hour to 9 days. Two patients never recovered consciousness following the initial trauma, both died. Three patients with a lucid interval of over 4 days (4, 5, and 9 days) all recovered. These facts would seem to show that, when the bleeding is not so rapid as to overwhelm the cerebral compensatory mechanisms, some form of readjustment can be reached, and that with proper operative therapy these patients usually recover.

Of 13, in whom a partial or a complete history could be obtained, 11 complained of *headache*.

In 5 patients *convulsions* were observed. In

2 the convulsions were Jacksonian in nature and were limited to the side opposite the lesion in the 3 other patients the convulsions were generalized

In 4 patients there was *bleeding from external orifices* 3 from the nose and 1 from the ears

On admission 14 patients had *visible evidences of head trauma* In 10 this was on the side of the lesion in 2 contralateral and in 2 others there was bilateral evidence of head trauma These findings are of importance for epidural hemorrhage nearly always occurs on the side of the trauma whereas acute subdural hematoma usually is found contralateral to the trauma

In 11 incontinence of urine and feces was noted

*Pupils* In 7 of the 17 patients epidural hemorrhage was on the side of the dilated pupil in 4 cases the lesion was on the side opposite the dilated pupil and in 6 the pupils were equal

*Vision* One patient had a right homonymous hemianopsia Here a fracture of the left occipital bone was found postmortem which had torn the posterior branch of the middle meningeal artery thereby causing an epidural clot There was also a laceration of the occipital lobe undoubtedly the cause of the visual field defect

*Papilledema* The fundi were seen in 16 cases The remaining fundus was invisible because of myosis and our refusal to use mydriatics lest pupillary evidence would be lost Four had papilledema 5 had engorged veins and in the 7 others the fundi were found to be normal The absence of papilledema should not militate against operative interference

*Motor phenomena* (1) Hemiparesis was the most constant motor abnormality It occurred in 13 cases in all but 1 the clot was found on the side opposite the lesion This is in contradistinction to acute subdural hematoma in which the hemiparesis if present is just as likely to be ipsilateral

2 Hemiplegia occurred in 4 cases always opposite to the clot Two of the patients had a hemiplegia on admission the 2 others

progressed from a hemiparesis to a hemiplegia under observation All 4 died Postmortem examination was performed on 2 of these patients and both showed the presence of brain laceration in addition to the epidural hemorrhage

3 Generalized rigidity was noted in 1 patient who died

4 Generalized flaccidity was noted in 1 patient who recovered

*Sensation* No accurate observations could be made on sensation Sensory examination in patients with head trauma is notoriously inaccurate and usually it is of little assistance in making a diagnosis of epidural hemorrhage

*Reflexes* (1) As to deep reflexes these findings were of no diagnostic value and for the most part depended on the patient's state of consciousness disappearing entirely when coma set in

(2) As to superficial reflexes there was a disturbance in the abdominal reflexes in all In 15 they were absent bilaterally and in only 2 cases were they absent only on the side opposite the lesion In like manner all had alteration in the plantar responses In 12 instances there was a bilateral Babinski sign usually more marked on the side opposite the lesion in 5 cases it occurred only contralateral to the lesion

*Mental state* All those patients who had had a lucid interval showed a progressive clouding of consciousness The picture varied from that of a state of clear consciousness to stupor and coma Only 2 (those with clear spinal fluids) had a truly clear lucid interval the others showed some improvement but rapidly lapsed from a confused state into coma

*Aphasia* Six had left sided hematomas We were able to do modified aphasia studies on 5 of these and 4 showed an aphasic language difficulty usually of a mixed type Of 11 cases with right sided hematomas only one showed an aphasia and at postmortem examination laceration of the contralateral temporal lobe was found To what extent the clouding of consciousness contributed to the aphasic picture of course is difficult to say but in each case it was the feeling of the exam

mers that they were dealing with a specific difficulty in language function

#### LABORATORY FINDINGS

*White blood count* was made in only 10 cases. All showed a polynucleosis and a leucocytosis varying in degree from 9,800 with 76 per cent polymorphonuclears to 17,200 with 86 per cent polymorphonuclears.

In 10 cases *serology of the blood and spinal fluid* was carried out; it was negative in all.

*Lumbar puncture* revealed the following types of fluid: (a) "Bloody" fluid. 11 of 15 patients had a bloody spinal tap. It should be noted that these cases are too often believed to have clear fluids. (b) Clear fluid. 3 patients had a clear spinal fluid. Two of these cases were diagnosed clinically and the patients were operated on, both recovered. We believe clear fluid indicates good prognosis, and bloody fluid bad. (c) Xanthochromic fluid. This was noted in 1 case on admission, 5 days after injury. The patient recovered. (d) In 2 cases spinal tap was not performed.

*Manometric pressure* readings varied from 60 to 560 millimeters of water.

*The temperature* varied from 99 degrees F to 107.8 degrees F prior to operation. No case with a pre-operative rise of temperature to above 104 degrees F recovered.

*The pre-operative pulse rate* varied from 32 to 170 per minute. Eight patients showed a drop in the pulse rate to below 60 per minute.

*The number and type of respirations* varied. In no instance was a respiratory rate of less than 16 per minute noted and if the condition was allowed to progress far enough the patients all developed the Cheyne-Stokes type of respiration.

*Roentgenograms of the skull* were made in 6 cases, in 5, a fracture line crossing the middle meningeal groove or one of the cranial venous sinuses was noted on the side of the lesion and in 1 case a fracture line was demonstrated on the side opposite to the clot. On the whole we believe clinical symptoms rather than roentgenograms should determine the diagnosis.

Four patients had an elevated *blood pressure* prior to operation. One had had hypertension for years prior to the accident. Of the 3 others, 2 died. The patient who recovered had a postoperative drop of the blood pressure to within normal limits. Two patients showed evidences of hypotension on admission to the hospital, both were in shock. We agree with Browder and Myers that an elevated blood pressure is not an accurate index of the presence of cerebral hypertension.

The *mortality rate* is shown in the following table.

MORTALITY RATE

	Case	Lived	Died	Mortality rate per cent
Total number operated on by neurosurgical service	11	5	6	54.5
Total number operated on by general surgical service	4	1	3	75.0
Not operated on (diagnosis not made)	2	0	2	100.0

*Postmortem findings.* Of the 9 patients who died, 5 were subjected to postmortem examination, all showed an associated skull fracture. Of greater interest, however, is the fact that all these cases had multiple brain lacerations. In 1 there was a contralateral subdural hemorrhage which had been missed because the patient had a trephine opening on one side only, and in 1 an epidural hemorrhage resulting from a laceration of the posterior branch of the middle meningeal artery was missed completely because the trephine opening was placed too far forward. The postmortem findings of the cases which were missed clinically have already been discussed. These findings illustrate the fallacy of speaking of a typical epidural hemorrhage syndrome. In these cases, the clinical picture is usually a result of the combination of brain edema, brain contusion or laceration, and the epidural hemorrhage.

#### SUMMARY

1. Seventeen cases of epidural hemorrhage were seen by members of the Neurological and Neurosurgical Services at the Bellevue

## SURGERY GYNECOLOGY AND OBSTETRICS

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Hospital during the 6 year period from 1930 to 1936

2 Fifteen of these 17 cases were subjected to operation the neurological service operated on 11 of these patients with a mortality of 54.5 per cent the general surgical service operated on 4 of these patients with an operative mortality of 75 per cent

3 The various signs and symptoms encountered are discussed and an attempt is made to determine various pre operative prognostic factors

4 The treatment of epidural hemorrhage has been discussed

5 The postmortem findings are included and indicate why a typical epidural hemorrhage syndrome does not exist



THE EFFECT OF DRUGS ON DIFFERENT SEGMENTS OF THE INTESTINE OF MAN<sup>1</sup>

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A VARIETY of drugs has been used, clinically, to combat and prevent postoperative intestinal distention associated with adynamic intestinal obstruction or paralytic ileus. Pituitrin and physostigmine, and, in more recent years, peristaltin (Ciba) (a glucoside of cascara sagrada) and acetylcholine have been the drugs which have been considered most effective in overcoming this condition. Our knowledge regarding the ability of these drugs to influence intestinal tone and motility is founded principally on the results of animal experimentation and the impressions acquired by clinical observation of the effects of the administration of these drugs to patients suffering from postoperative intestinal distention. Only a few experimental studies on the intestine of man, as far as we are aware of, have been recorded. These comprise a study carried out by Cross, in which he investigated the effect of pituitary extract and physostigmine on isolated strips of the appendix taken from patients at operation, and a number of studies on humans by other investigators in which the effects of several of these drugs on the gastro-intestinal tract have been observed with the fluoroscope (2, 3, 5, 6). In this paper a review of the literature will not be attempted. This has been done very completely in a paper by Ochsner, Gage, and Cutting, in which the authors reported the results of a similar study carried out on dogs.

On the intestinal service at St. Mary's Hospital, there always are many patients who have had either a sigmoid or a transverse colostomy established for an organic lesion at a point distal in the colon or in the rectum. Occasionally, too, there is the patient who has had an ileostomy performed as the preliminary stage of total colectomy. It was recognized, therefore, that an excellent opportunity was at hand to observe the effects

of these drugs on different segments of the human intestine.

## THE DRUGS STUDIED AND THE METHOD EMPLOYED IN THE OBSERVATION OF THEIR ACTION ON THE HUMAN INTESTINE

The drugs, whose action on the intestine was studied, were (1) surgical pituitrin, (2) physostigmine salicylate, (3) peristaltin or soluble extract of cascara sagrada, grains  $2\frac{1}{2}$  (0.152 gm.) per ampul, prepared for hypodermic injection, and (4) acetylcholine. We observed the effect of these drugs on three different levels of the intestinal tract, the sigmoid flexure, the transverse colon, and the terminal portion of the ileum. In every instance, their administration was by intramuscular injection.

The apparatus employed for recording intestinal movements in the following observations consisted of two pieces of rubber tubing, each of which was  $\frac{3}{4}$  inch in diameter and  $3\frac{1}{2}$  feet in length. One end of one of these lengths of rubber tubing terminated in a thin rubber balloon which was  $3\frac{1}{2}$  inches in length and approximately the same diameter as the lumen of the intestine. When, therefore, the balloon was inflated to a point short of distention, it filled the lumen of the bowel completely without exerting any tension at the site in which it was lodged. The stoma of the balloon was attached to the end of the rubber tubing by means of rubber cement and tight ligation with linen thread, and in this way the possibility of the leakage of air at this point was prevented. One end of the other length of rubber tubing was connected with a tambour and writing lever. The diaphragm of the tambour, which was composed of the same type of rubber as the balloon, was also fixed in position by means of rubber cement and tight ligation with linen thread, in such a manner

<sup>1</sup>Abdgment of thesis submitted by Dr. John S. Guthrie to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery. Work done on Intestinal Service, St. Mary's Hospital, Rochester, Minnesota.



Fig. 1. Kymographic tracing showing the small rhythmic waves of contraction that occur normally in transverse colon (b) in sigmoid flexure and (c) in ileum.

as to insure against the leakage of air from within the recording system at this point. The end of the recording lever of the tambour was fitted with a writing point which would record the intestinal tracings on smooth unsmoked kymographic paper. A single paper kymograph was used and the drum adjusted to rotate at a uniformly slow rate of speed. The free ends of the two lengths of rubber tubing were connected by a three-way stopcock by means of which air could be introduced into the system and adjusted to the desired degree of pressure. The recording system was carefully tested before each experiment in order to make certain that there was no leakage of air at any of the connections or at any point between the balloon and tambour. During the entire course of this investigation the physical disposition of the apparatus was not changed.

For each observation we selected patients who had undergone colostomy not more recently than 2 weeks previously, who were in good general condition and whose bowels and colonic stomas were functioning normally. Care was taken that the patient had not received a laxative or cathartic of any kind for at least 48 hours prior to each observation. During each observation the patient reclined in the supine position on a couch in a room that had been specially set aside for the carrying out of this study. Hence the patient during the entire course of each observation was free of extraneous influences which might cause reflex nervous irritation.

After the recording apparatus had been tested and set in readiness the rubber balloon was inserted through the colonic stoma and by means of inflation and deflation it was manipu-

lated into its desired position within the lumen of the intestine at least 2 inches beyond the inner level of the abdominal wall. In order to maintain the balloon in position and to prevent it from being extruded from the intestine by peristaltic activity the portion of rubber tubing immediately outside the colonic stoma was firmly anchored to the abdominal wall by means of adhesive tape. Air was introduced through the stopcock into the recording system and adjusted to the desired degree of pressure. The writing point was lightly contacted with the kymographic drum and tracings of intestinal activity recorded.

#### RESULTS OF OBSERVATIONS

At the commencement of the observations it was found that when air was introduced into the recording system to inflate the balloon, if the amount that was introduced was sufficient to distend the balloon to a point where it caused tension on the intestinal wall, large strong contractions of the intestine resulted because of the stimulation mechanical in nature that was thus produced. These contractions tended to occur every  $1\frac{1}{2}$  to 3 minutes and to continue as long as this tension in the balloon was maintained. Because of this it was necessary to determine the exact degree of pressure essential to render the balloon sufficiently sensitive to record the slightest change in intestinal tone and motility in the kymographic tracing and yet not produce any tension within the intestinal lumen.

It also was observed that the placement of the balloon in the intestine invariably stimulated the bowel immediately to increased peristaltic activity. This did not subside and the bowel did not return to normal until about

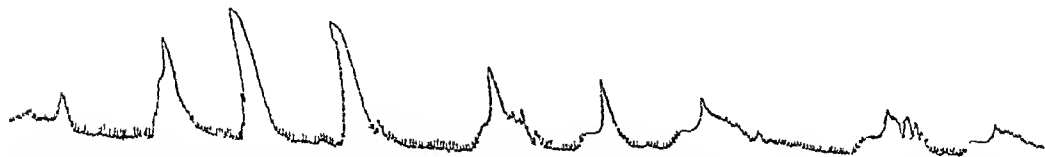


Fig 2 Kymographic tracing of the transverse colon, showing the huge waves of contraction that occur following the intramuscular injection of 1 cubic centimeter of pituitrin

half an hour later. Because of this, on each day that observations were made, the tracing always was obtained for at least 1 hour, and care was taken to see that the character of the tracing remained normal for at least half an hour before the drug, to be studied that day, was administered. In this way, the possibility of the drug being credited with having produced an initial excitant effect on the intestine was prevented.

The tracings that are normal for the transverse colon, sigmoid flexure, and ileum are characterized by the presence of a series of small waves that tend to occur rhythmically throughout the length of the tracing (Fig 1). These waves are not so prominently seen, however, in tracings of the sigmoid flexure. The normal tracing of the sigmoid flexure is represented by more or less of a straight line.

During the entire course of this observation, one drug only, as a rule, was used on the same day and at no time were more than two different drugs used. If two drugs were used, the second was not administered until we were certain that the first drug had not had any effect on the bowel, or until the effect of the first drug had subsided completely. The second drug was not administered until the tracing had continued approximately normal for at least half an hour or more after administration of the first drug.

*The transverse colon.* In studying the effect of these drugs on the transverse colon, all observations were made on the same patient. This patient was a man who had had a colonic stoma established at the midportion of the transverse colon 6 months previously, for an obstructing lesion of the sigmoid flexure. The balloon was placed in the distal limb of the colon and was therefore free from interference by the fecal current. Observations were made on 9 different days, during this time 1 cubic centimeter of pituitrin was given on five dif-

ferent occasions, 1/100 grain (0.0006 gm) and 1/35 grain (0.0018 gm) of physostigmine salicylate were administered on separate days. Four ampuls of peristaltin were administered in 3 days, on one of these days, 2 ampuls were administered, 1 ampul was given 1 hour and 23 minutes after the first. Acetylcholine was given on four different days, the dose used was 100 milligrams the first day, 200 milligrams the second day, and 400 milligrams on the third and fourth days.

*Pituitrin.* Within 3 to 5 minutes after each administration of pituitrin, huge waves began to appear in the kymographic tracing, which indicated that the drug had caused large powerful contractions to occur in the colon (Fig 2). These waves occurred every 3 to 5 minutes, the magnitude of each wave gradually diminished until the waves ceased 3/4 to 1 1/2 hours later, when the effect of pituitrin on the bowel apparently had subsided. During this time, the patient complained of abdominal cramps, which at first were severe, borborygmus was present and a copious passage of feces occurred from the colonic stoma.

*Physostigmine.* No apparent effect was observed for 1/2 to 2 hours following the injection of either 1/100 grain (0.0006 gm) or 1/35 grain (0.0018 gm) of this drug. No alteration from the normal occurred in the kymographic tracing. The patient did not experience cramps of even a mild nature, borborygmus was not present, and there was no passage of feces from the colonic stoma.

*Peristaltin.* On 2 of the 3 days on which 1 ampul of peristaltin was administered, some evidence of action by the drug on the bowel was observed. This was indicated by the appearance in the kymographic tracing of slight to medium sized waves in 3 to 9 minutes after administration of the drug (Fig 3). These waves continued to occur at irregular intervals of from 1 1/2 to 7 minutes for almost 1 hour.

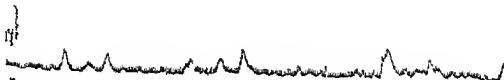


Fig. 3. Kymographic tracing of the transverse colon showing the regularly occurring small to medium sized waves of contraction that followed the intramuscular injection of pituitrin.

During this time the patient experienced an occasional mild cramp but borborygmus was not present and the passage of fecal material did not occur from the colonic stoma. On the other day on which this drug was administered no evidence of its effect was observed in the kymographic tracing; cramps or borborygmus did not occur and feces was not passed from the colonic stoma.

**Acetylcholine.** Following the administration of 100 milligrams, 200 milligrams or 400 milligrams of this drug no effect on the bowel was observed in the tracing and there was not any subjective or objective manifestation.

**Sigmoid flexure.** We observed the action of the sigmoid flexure of four patients each of whom had had a colonic stoma established in the left inguinal region because of a malignant lesion in the rectum. Observations were made on 7 different days. One cubic centimeter of pituitrin was administered on 4 separate occasions. 1/50 grain (0.0013 gm.) of physostigmine salicylate was administered once. 1 ampul of peristaltin was administered on four different occasions. 350 milligrams of acetylcholine was administered on one day and 400 milligrams on a second and third day.

**Pituitrin.** The effect produced by pituitrin on the sigmoid flexure was identical with its effect on the transverse colon. Within 3 to 5 minutes after each injection of the drug large powerful contractions of the colon occurred; these were evidenced by the appearance in the kymographic tracing of waves of great amplitude. These waves continued to occur every 3 to 5 minutes in gradually diminishing magnitude during the 1/2 to 1 hour or more that observations were made. Following each injection of pituitrin the patient experienced abdominal cramps which at times were quite severe; borborygmus was present and large amounts of feces were expressed from the colonic stoma.

**Physostigmine.** About 1 1/2 minutes after injection of 1/50 grain (0.0013 gm.) of physostigmine salicylate small to medium sized waves appeared in the kymographic tracing and these waves continued to occur in the tracing at intervals of from 1 to 8 minutes during the hour that observations were subsequently carried out. The patient however did not experience abdominal cramp even of a mild character; borborygmus was not present and while there was not any passage of feces from the colonic stoma, gas in somewhat increased amounts was expelled at the times that the largest waves appeared in the tracing.

**Peristaltin.** On the three occasions on which peristaltin was administered observations were made for a period of 1 hour or longer after each injection of the drug. On 2 of the 3 days a few small waves appeared at irregular intervals in the kymographic tracing which indicated that slight peristaltic stimulation of the bowel had been produced by the drug. At no time however was there any other evidence of effect on the bowel by the drug.

**Acetylcholine.** Observations were continued for 1 hour following each injection of this drug. In one instance about 9 minutes after 400 milligrams had been administered some increase in the tone of the colon as indicated by a slight elevation of the base line of the tracing was observed. This increase in tone was of short duration; however as the bowel returned to its normal state in about 9 minutes a few very small waves of contraction also were observed to occur at irregular intervals for about three fourths of an hour. Aside from this there was no other evidence of the effect of the drug on the bowel. Cramps, borborygmus and the passage of feces from the colonic stoma did not occur.

**Terminal portion of the ileum and the sigmoid flexure.** We observed the effects of these drugs on the terminal portion of the ileum of

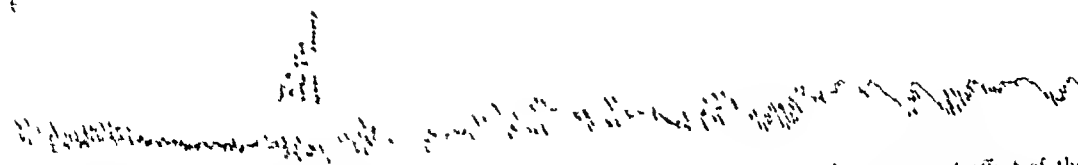


Fig. 4. Synchronous kymographic tracings of the ileum and sigmoid flexure, showing the concurrent effect of the intra-ileal injection of 1/50 grain (0.0013 gm) of physostigmine salicylate on both these segments of bowel. In the ileum a definite increase in both tone and intestinal movement is seen almost immediately following administration of the drug. In the sigmoid flexure, after a somewhat longer latent period, a slight but definite increase in intestinal movement is apparent.

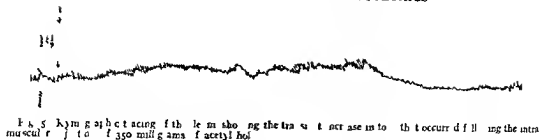
a man who previously had been subjected to two of the procedures of total colostomy, as carried out in three stages. The first procedure had consisted in the establishment of an ileac stoma, at the second operation a combined abdominoperineal resection of the rectum and the distal third of the sigmoid flexure had been performed. At the time, therefore, that the following observations were made, this patient possessed both an ileac and a colonic stoma. By the employment of two identical recording systems it was possible, by placing the balloon of one system within the lumen of the ileum through the ileac stoma, and by placing the balloon of the second system in the lumen of the upper portion of the sigmoid flexure through the colonic stoma, to obtain synchronous tracings of these two portions of the intestinal tract.

**Pituitrin.** Within 2 minutes following the injection of 1 cubic centimeter of pituitrin large waves appeared in both the ileac and sigmoid tracings, which indicated that pituitrin had stimulated powerful contractions in both the ileum and the sigmoid flexure. These waves occurred in gradually diminishing intensity every 1½ to 3 minutes during the 55 minutes that observations were subsequently carried out. At the same time, the patient complained of abdominal cramps, at first severe, borborygmus was present and large amounts of liquid feces were passed from the ileac stoma.

**Physostigmine.** Physostigmine salicylate, grain 1/50 (0.0013 gm) was administered on 2 different days and observations were made for 1 hour and 40 minutes. Following one of

these injections, no effect was evidenced on either the ileum or sigmoid flexure. On the other of these days, almost immediately after the injection of the drug, a definite and prolonged increase in the tone of the ileum was observed, as evidenced by a rather marked elevation of the base line of the ileac tracing from the normal (Fig. 4). Some motor stimulation of the ileum also occurred, as indicated by slight to medium sized waves which appeared every 1½ to 5 minutes in the ileac tracing and continued in gradually diminishing amplitude during 1 hour, 40 minutes that observations were made. With regard to the sigmoid flexure, although no alternation occurred in the tone of this portion of the bowel, slight to moderate sized waves of contraction appeared in the sigmoid tracing about 10 minutes after the administration of the drug, and these continued to occur every 2 to 6 minutes until observations were discontinued. At no time, however, did the patient experience abdominal cramps, and feces was not expelled from the ileac stoma.

**Peristaltin.** Peristaltin was administered on 2 different days, 1 ampul was the dose administered at each injection. On the first day, 1 ampul only was given, without the production of any apparent effect on either the ileum or colon. On the second day, 1 ampul was given, and this dose was repeated ½ hour later, observations were made for 1¼ hours after administration of the first dose of the drug. Aside from the occurrence of a slight increase in the tone of the ileum, which lasted for about 20 minutes, no other evidence of effect was observed on either the ileum or the sigmoid flexure.



**Acetylcholine** Acetylcholine was administered on 2 different days. On the first day a dose of 250 milligrams was given without the production of any apparent effect on either the ileum or the colon. On the second day following the injection of 350 milligrams a slight increase in the tonus of the ileum was observed (Fig. 5). This however was of short duration the ileum returned to its original state of tonus about 6 minutes later. Aside from this effect no other evidence of action by the drug was observed.

At the time of the third stage of the operation all of the colon down to within a short distance of the colonic stoma was removed. This left the patient with a small isolated loop of sigmoid flexure approximately 3 inches in length which terminated blindly at its proximal end and communicated externally by means of the colonic stoma. This small pouch of bowel was known to possess only one small artery. When the patient had recovered sufficiently from the operation a balloon was introduced into this isolated loop and 1 cubic centimeter of pituitrin was administered to determine if such an isolated loop of bowel would respond to the effects of the drug as did the intact colon. Within a few minutes following injection of pituitrin contractions occurred in this small segment of colon these were as powerful and vigorous as were the contractions observed in any of the preceding observations in which this drug was used (Fig. 6).

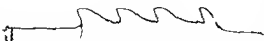


Fig. 6. Kymograph tracing of the isolated segment of colon after administration of 1 cubic centimeter of pituitrin. The tracing shows a series of regular, sharp, and sustained oscillations, indicating powerful and vigorous contractions.

#### SUMMARY AND CONCLUSIONS

A series of observations have been made in an endeavor to determine the effectiveness of surgical pituitrin, physostigmine, penstaltin (Ciba) and acetylcholine as stimulants of tone and motility of the human intestine. Patients who had been subjected to colostomy and ileostomy were observed. By means of a graphic method that involved the introduction of a rubber balloon into the lumen of the transverse colon, sigmoid flexure and terminal portion of the ileum it was possible to estimate the effect of these drugs on these different portions of the intestinal tract.

Of these 4 drugs pituitrin alone was found to be a marked stimulant of the human intestine and in the light of the results of these observations it is the only drug of this group that is likely to prove effective regularly as a therapeutic agent in augmenting the peristalsis of an atonic or paralyzed bowel. The effect on the intestine that was observed to follow every administration of pituitrin was so constant that we feel justified in concluding that this drug (1) is a powerful stimulant of intestinal peristalsis, (2) is constant and regular in its action, (3) acts with apparently equal strength on both the colon and the ileum, (4) increases the motility of the intestine without apparently exerting any effect on the tonus, and (5) is rapid in its action. Following its administration it acts within 3 to 5 minutes and its action extends with gradually diminishing effect for from  $\frac{3}{4}$  to  $1\frac{1}{2}$  hours.

Physostigmine and penstaltin although they were observed at times to increase the tonus as well as the motility of the colon and the ileum definitely were found to be inconsistent and uncertain in their action. Moreover the peristaltic contractions which each

of these drugs produced were relatively mild, less regular in their occurrence, and totally lacking in propulsive force as compared with those contractions that followed each injection of pituitrin.

It has been said that, in order to produce the full therapeutic effect of physostigmine on the bowel, a dose of the drug as large as 1/20 or 1/16 grain (0.003 or 0.004 gm.) should be administered. In the instance during this observation, however, in which 1/35 grain (0.0018 gm.) of physostigmine salicylate was administered, the patient shortly after the injection of the drug experienced a feeling of great weakness and dizziness, and marked illness developed. A similar, though milder, systemic reaction at times followed the administration of 1/50 grain (0.0013 gm.) of the drug. For this reason, larger doses of physostigmine than those employed in this observation were not used.

As regards acetylcholine, the results of this observation would indicate that this drug possesses little worth as a stimulant of the human intestine. On 7 of the 9 occasions on

which the drug was employed in doses ranging from 100 to 400 milligrams, no evidence of any effect on the intestine was in any way apparent. On the two occasions on which some increase in either the tone or the peristaltic activity of the colon and the ileum was observed to occur, the stimulative effect of the drug was relatively slight and insignificant, as well as transient in character.

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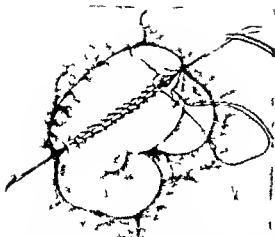


Fig 1 With the serous sacs exposed in apertures by  
 a section a continuous line of silk is placed through  
 the serous sacs and the body of the wall of the  
 stomach and the intestine forming the first posterior  
 furrow line of the anterior end.

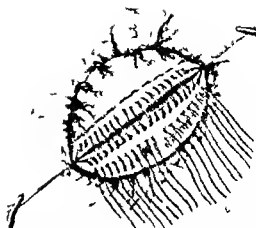


Fig 2 The matter sacs are in place and the  
 sutures are put. These will form the first line of  
 the structure of the stomach. The dotted lines  
 indicate the position of the stomach and intestine  
 to be made.

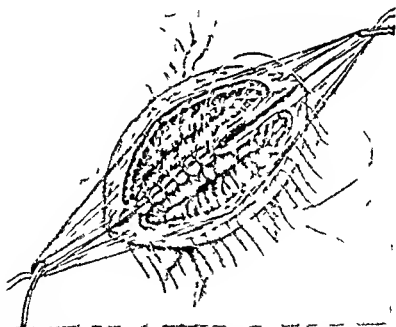


Fig 3 The matter sacs are placed and the matter is the stomach  
 and the intestine is made by the dotted line shown in the  
 section of the stomach. The dotted line is placed through the wall of the stomach  
 and intestine to form the second line and the third line of the wall of  
 the stomach. The matter is filled with the matter of the stomach.



# CLINICAL SURGERY

FROM SURGICAL DEPARTMENT, NEW YORK HOSPITAL

## GASTRO-ENTEROSTOMY

A DETAILED DESCRIPTION OF ONE SURGICAL PROCEDURE

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THE medical literature offers many discourses on the comparative merits of the medical and surgical treatment of lesions of the stomach. The controversial points are hotly disputed by physicians, surgeons, and roentgenologists, and different operative procedures are defended by the champions of each. In this profusion of literary material there appear to be few simple and complete descriptions of any one surgical method, excepting the early original papers to re-emphasize the details of one type of gastro-enterostomy, this paper is presented.

Clinical records of patients who died of gastric obstruction may be found in the earliest medical writings. The nature of the obstructing lesion was of little importance in this era, for all patients died of starvation. One of the most dramatic accomplishments of surgery was the relief of gastric obstruction by gastro-enterostomy. This operation was not one of the first procedures to be developed after the introduction of asepsis, hemostasis, and anesthesia, but it has become an accepted and commonplace method of treatment. In general, little thought is given to those who first conceived a surgical procedure, nor to those who subsequently labored to improve it and who brought it to its present state of perfection.

Anton Woelfler, assistant to Professor Billroth, performed the first recorded gastro-enterostomy on a living human being, in 1881. The operation had been devised by his predecessors, Nicoladini in particular, and Woelfler had been instructed by Billroth to attempt the operation when next a suitable case of pyloric obstruction was encountered in the clinic. This moment arrived while Billroth was absent from the clinic, the operation was an anterior gastro-enterostomy for an inoperable carcinoma near the pylorus. It was successful in spite of the fact that the patient was in a deplorable state of emaciation.

Later attempts to perform this operation were less favorable in their outcome. In 1884, Dr. Joseph Ransohoff performed a gastro-enterostomy in Cincinnati. The patient, in a serious condition owing to the presence of a malignant growth at the pyloric end of the stomach, succumbed 8 hours after operation. Ransohoff's was the first attempt to carry out this operative procedure in the United States and, according to him, the seventh to be reported anywhere in the literature.

Various types of gastro-enterostomies have been developed in the 54 years which have elapsed since Woelfler opened up this field of surgery. The early surgeons placed the stoma low on the anterior wall of the stomach, later operators selected a site near the cardia and from there it was shifted to the mid-portion, near the anti-mesenteric border and finally to the pyloric end.

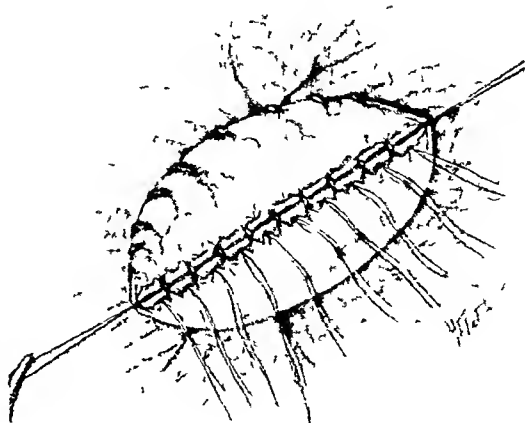


Fig. 4. The mattress sutures have been tied, the reinforcing sutures then placed, and cut as tied to complete the anterior wall of the anastomosis.



Fig 5 This illustrates typical stomach with pyloric obstruction. It is dilated, the pylorus is visible, and the stomach is filled with food. The pylorus is the opening of the stomach into the small intestine.



Fig 6 The same stomach after gastro-enterostomy. The stomach is no longer dilated, and the pylorus is no longer visible.

of the stomach. When the posterior gastro-enterostomy was devised by Courvoisier in 1883, with the stoma near the pylorus, the functional results began to improve.

A large variety of sutures have been recommended for use in gastro-enterostomy. Ingenious devices have been manufactured in the hope that an aseptic anastomosis might be secured between the stomach and the intestine. The Murphy button was devised to shorten the operative procedure. Clamps which approximate and hold in position the loop of bowel and the gastric wall and prevent leakage of their contents are in general use today.

Some of the surgeons who have made contributions to the development of gastro-enterostomy are Halsted, Moynihan, Mayo, Walton, Willue, and Judd. Gastro-enterostomy is generally conceded to be successful in only 80 per cent of all cases in which it is used. The fact that failures are encountered in 20 per cent of the patients challenges the surgeon of today to greater effort to improve his technique. It is believed that close adherence to an operative method which has yielded good results may, in part, diminish the unfavorable results in gastro-enterostomy. Such a method is described in full in the following pages. If it does no more than stimulate discussion, this

paper seems justified, for where controversy is plentiful, progress may be expected.

#### PREPARATION FOR OPERATION

*Pre-operative preparation of the patient.* During his stay in the hospital before operation, the patient is kept in bed and on a liquid diet of high caloric value. Dental hygiene is instituted to diminish the organisms of the mouth which are potential factors in infection.

*Pre-operative preparation of the stomach.* Many variations in the technique of gastro-enterostomy have been devised to prevent soiling of the peritoneal cavity. It is our opinion that decompression and cleansing of the gastro-intestinal tract before operation is of greater value than any elaborate operative method to obviate contamination of the peritoneum. The stomach which is partially or completely obstructed is usually dilated; its walls are atonic and hypertrophic, and bacteria are present in large numbers. Decompression and cleansing of the stomach may be accomplished by gastric lavage once or twice a day over a period of from 5 to 10 days. The result of this treatment is threefold: (a) the stomach is diminished in size, (b) the gastric walls become more elastic, and (c) the bacterial flora is reduced. Each of the three results of this treatment is of distinct advantage to the operator; there is less danger of infection, the stomach

is easier to handle because it is small, and the anastomosis is more satisfactorily accomplished because the stomach wall is not congested, edematous, and atonic.

#### OPERATION

The operation was devised by Halsted, who carried out a long series of experiments on lateral and end-to-end anastomoses of the intestine between 1885 and 1890. Later he applied to gastro-enterostomy his findings in lateral intestinal anastomosis and developed the operation which bears his name. The Halsted gastro-enterostomy differs from others in four points: (1) No clamps are used. When clamps are employed in gastro-enterostomy there is danger of injuring the walls of the stomach and intestine. The destruction of one of the gastric wall cannot be considered a serious matter, but loss by devitalization of intestinal wall is obviously undesirable. The common objection to gastro-enterostomy without clamps is that the contents of stomach and intestine, if allowed to escape into the wound, may cause peritonitis. If the contents of the gastro-intestinal tract have been rendered harmless by lavage before operation, there is little fear of infection. (2) All vessels are ligated individually as they are encountered. It is believed that the clamp, in crushing the wall of the stomach and intestine, temporarily seals vessels which may begin to bleed when the blood pressure is increased, as during postoperative vomiting. When each vessel is ligated separately, there is little danger of hemorrhage after operation. (3) Interrupted sutures are used for part of the closure of the anastomosis. If a continuous suture is placed so that it encircles the entire opening between the stomach and intestine, it tends to contract the lumen and to make its edges rigid. A valve-like action may result which obstructs the passage of gastric contents. By placing interrupted sutures in the anterior section of the gastric wall, this tendency may be counteracted. (4) Silk is employed as suture material to unite the submucous, muscular, and serosal layers of the stomach and intestine. It appears to create less reaction than do sutures of catgut or other material. It is desirable to diminish swelling and congestion around the opening which is made, to insure immediate good function.

**Operative approach.** The operative approach is through an upper right rectus incision. The opening in the transverse mesocolon should be ample for good exposure of the pyloric portion of the stomach. It cannot always be placed at the desired point owing to variations in the length of

the mesentery and in the arrangement of its vessels. When possible it should be to the left of the middle colic artery and parallel to it so as not to disturb the circulation of the mesentery. The upper extremity of the slit should lie at some distance from the large bowel so that the intestinal lumen is not compromised when the mesentery is sutured to the stomach after the anastomosis has been completed.

**Choice of site for the anastomosis.** When the stomach has been delivered through the slit in the mesentery, it is explored for the purpose of selecting the site for the stoma. To permit early and adequate emptying of the stomach, the artificial orifice should be placed diagonally across the posterior surface of the prepyloric region. At operation this may not be the most dependent portion of the stomach, for the section which appears to be at the lowest point in a dilated stomach, may not retain this position when the organ is reduced in size. An opening placed in the dependent part of a distended stomach may be found, in postoperative roentgenograms, to drain only the upper half of the gastric contents. The stoma should measure about 10 centimeters in length. Traction sutures are placed in the gastric wall so as to mark each end of the contemplated opening, and while they are held under slight tension, a loop of jejunum is brought into the wound.

Two points must be considered in selecting the loop of jejunum to be anastomosed to the stomach. First, the peristaltic waves in it, below the anastomosis, must move in the same direction as the waves in the stomach. Second, the loop of jejunum above the anastomosis must be sufficiently long to prevent tension, but not long enough to permit puddling, or to act as a reservoir for food. The proximal end of the stoma in the jejunum should be 10 to 15 centimeters from Treitz's ligament. It should be placed midway between the mesenteric attachment and the opposite free side of the jejunum, i.e., at a distance from the mesentery of about one-fourth of the total circumference of the intestine. The traction sutures, previously placed in the stomach are now carried through the intestinal wall at each end of the site selected for the stoma. Traction on these sutures now brings the serosal surfaces of the stomach and intestine in alignment. In this position a continuous suture of silk is introduced through the serosa, muscularis, and submucosa of each organ so as to form the posterior wall of the anastomosis (Fig. 1). Mattress sutures are now placed so that, if tied, they would unite the walls of the stomach and jejunum at a distance

of about 1 centimeter from the continuous suture line just described (Fig 2). These sutures are  $\frac{1}{2}$  centimeter apart and extend the length of the contemplated stoma. When completed they are loosened sufficiently to allow an instrument to pass under the suture. A clamp inserted between the middle mattress sutures and passed under them to one end of the intended stoma is made to grasp and hold the traction suture while the instrument is withdrawn. The same maneuver is carried out with the traction suture at the opposite end. The site of the stoma may now be exposed by retraction on the traction sutures which reflect half of the mattress sutures to each side (Fig 3).

The gastric wall is now incised  $\frac{1}{2}$  centimeter from the continuous suture of silk. Bleeding vessels are secured with hemostats and ligated with plain (No. 00) catgut as soon as the stoma is completed. An opening in the jejunal wall in a similar position and of the same length is made. The vessels are caught and tied as in the stomach. Over the initial continuous suture of silk a continuous lock suture of plain (No. 1) catgut is introduced through the entire wall of intestine and stomach and carried just beyond the extremities of the incisions. When all bleeding from gastric and intestinal surfaces has been controlled the mattress sutures are tightened. The mucosa is carefully inverted while the walls of the two organs are approximated by drawing up on these sutures. When they are tied interrupted silk sutures are placed between them to reinforce the closure further (Fig 4). The transverse mesocolon is now anchored to the gastric portion of the anastomosis with interrupted silk sutures. This prevents herniation of small bowel through the defect in the transverse mesocolon.

The abdomen is closed without drainage. Continuous chromic catgut is used to approximate the peritoneum. Any sutures of a durable non absorbable material such as silk worm or dermal are passed through the external rectus sheath down to but not through the muscle. The fascia is closed with interrupted sutures of chromic (No. 1) catgut. Interrupted silk sutures bring the skin edges together.

#### POSTOPERATIVE TREATMENT

The postoperative treatment begins as soon as the patient returns to bed with the subcutaneous administration of 1500 cubic centimeters of saline solution. Carbon dioxide is given every 2 hours to hyperventilate the lungs. When consciousness is regained the patient is placed in a low Fowler's position. At this time also morphine is ad-

ministered in amounts sufficient to abolish pain on breathing. Patients over 50 years of age may develop pulmonary emboli and it is felt that shifting the position of such patients every 2 hours may prevent thrombosis after gastro-enterostomy.

Six to 8 hours after operation 500 cubic centimeters of 10 per cent glucose in saline is given intravenously. If the patient has been depleted by the operation or if his red blood cell count is low a small transfusion of blood is preferable. The fluid intake for 24 hours is maintained near a 3000 cubic centimeters total.

The usual regimen after gastro-enterostomy is

For 48 hours N. G. by m. th.  
 Third day 3 ccm of t. r. e. ry hour  
 Fourth day 6 ccm of w. t. e. ry hour  
 Fifth day 60 ccm f. w. t. e. n. the h. 60 ccm. f.  
 alb. m. u. w. t. e. r. b. t. t. milk. th. odd h. r.  
 Sixth day 90 ccm f. w. t. e. n. the h. 90 ccm. f.  
 alb. m. u. t. s. or butt. milk. on th. odd h.  
 Seventh day 1 ccm f. w. t. the e. h. c. m.  
 f. lb. m. u. w. t. r. butt. milk. n. th. odd h. r.  
 Eighth day 10 ccm. f. w. t. e. r. th. e. h. u. r. o. cm.  
 of lb. m. u. w. t. b. t. termilk. on th. odd h. r.  
 coddled egg morn. g. nd. ening.  
 Ninth day 16 t. r. d. l. b. 6 sm. l. m. is containing f.  
 pp. ximately 45 grams f. protein. 1 gr. m. f. carb.  
 hyd. t. a. d. 2 grams f. fat. and 1 tall g. 100  
 calo. i. s.  
 Tenth day 4 to fourt. th. G. dually each fed g. s. u.  
 ced f. m. o. o. t. 500 grams. F. m. the m. th. d. y.  
 milk eggs soup. eat b. ead m. t. eg. tables, and  
 fru. t. a. e. add d. t. th. diet.  
 Fourteenth day 1 fl. oz. g. d. y. 80 gr. ms. p. ot.  
 gram f. t. a. 5 gram. ca. b. hyd. ate. This q. l. n. ly  
 4000 cal. ses. It is g. n. in 6 f. d. g. s. f. app. m. t. ly  
 500 g. ams. each.

The patient is allowed up on the fourteenth postoperative day. Then his fluid and caloric intake are sufficient for his needs. The first fluoroscopic examination is given at this time.

#### COMPLICATIONS

The immediate postoperative routine described meets the needs of the majority of patients but cannot be adhered to when complications arise. The more common complications after gastro-enterostomy are:

**Vomiting.** A patient who continues to vomit after the effects of the anesthesia have worn off sometimes can be relieved by gentle lavage of the stomach with warm saline solution. We believe this procedure to be without danger and it may be by washing out clots or other material retained in the stomach overcome the tendency to vomit.

**Hemorrhage.** The best insurance against postoperative hemorrhage is careful ligation of all bleeding vessels during the operation. If there is

evidence of bleeding at any time, a small nasal tube is introduced into the stomach to determine the presence or absence of blood

**Pulmonary complications** These are combated in the usual manner, by change of the patient's position in bed, by hyperventilation of the lungs, and by giving sufficient morphine to abolish pain and allow deep respiratory excursion

**Distention.** Distention, especially of the large bowel, should be avoided after gastro-enterostomy. Adequate pre-operative evacuation of the gastro-intestinal tract tends to prevent postoperative distention. In the early stages of this complication the colon may be decompressed by enemas

**Failure of the stoma to function** At the beginning of the second week after operation, when the patient is taking a fair amount of liquid nourishment by mouth, there may develop signs of gastric obstruction which, on lavage, may appear to be almost complete. Under these circumstances the routine diet for the fourth day should be resumed and the stomach lavaged daily. In some instances the obstruction persists through the second postoperative week, after which period the stoma functions perfectly. Postoperative edema and spasm of the small bowel may play a part in the production of such a temporary obstruction. If the stoma proves to be inadequate in size, operative intervention may be necessary

#### POSTOPERATIVE X-RAY EXAMINATION

Carty, Weintraub, and Felter have studied large series of patients after gastric operations. They point out that poorly functioning gastro-enterostomies may be earlier determined by x-ray examination than by clinical symptoms. It would appear that there is no better method of estimating the function of a gastro-enterostomy than by its visualization under the fluoroscope after barium has been administered. To determine the result of operation a small amount of barium is given the patient in front of the fluoroscope prior to his discharge from the hospital. No ill effects from this treatment have been noted. The location of the stoma and, to a certain degree, its size may be determined. These are the two variables which account for the majority of poor results after gastro-enterostomy.

The patient is re-examined 6 months after operation. By the end of the sixth month the stoma will have assumed a permanent position and size. Fluoroscopic examinations are, therefore, limited to 1 a year, if the patient is free of complaints referable to the gastro-intestinal tract.

Beginning marginal ulcers and recurrent ulcers may be discovered by x-ray before marked symptoms have appeared, and treatment can be instituted at once with the avoidance of serious late manifestations and complications. The treatment may consist in enforced rest and careful adherence to a rigid diet. However, it may demand surgical intervention. If this is the case, then surgery may be undertaken before perforation occurs, an incident which obviously adds to the risk of operation. If the surgeon is present and makes the observations with the roentgenologists, he has an opportunity to study his cases with a view of improving his operative procedure.

The 2 roentgenograms illustrate the value of this form of check on the results obtained.

Figure 5 illustrates a typical stomach with pyloric obstruction. It is dilated to almost three times the size of the normal stomach, although the obstruction is incomplete. In Figure 6, the same stomach is shown after gastro-enterostomy. All the requirements for a good therapeutic result are present, the stomach has markedly decreased in size, the stoma is near the pylorus and, although the exact diameter is not visualized it is adequate, for only a small amount of barium is retained in the stomach, the duodenum and jejunum may be seen from the pyloric sphincter to the anastomosis, the loop is not sufficiently long to permit puddling. The distal loop functions well for the barium has penetrated into the small intestine below the anastomosis.

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## SURGERY GYNECOLOGY AND OBSTETRICS

CARE OF THE RUPTURED APPENDIX<sup>1</sup>

REDUCTION OF MORTALITY TO FOUR PER CENT BY SERIES OF FIFTY CASES

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**APPENDICITIS** is a disease of common occurrence and of great diversity in its clinical course. It is so often of extreme gravity especially in young subjects and so disconcerting in its evolution that its treatment may be said to be always a matter of deep solicitude to the surgeon. He must be prepared to grapple with it at a moment's notice as it were and muster all his skill and knowledge to win the fight.

So real however has been the progress within recent years in its surgical treatment that aside from accidents and complications such as embolism ileus and other obstructive or inflammatory sequelae the unruptured appendix should carry little or no mortality. This is true whether the organ be chronically inflamed of inter-al type or in a state of acute inflammation. It is for this reason that physicians and even well informed lay persons insist upon immediate operation as soon as the diagnosis of appendicitis is made.

At the outset the diagnosis may not be one of absolute certainty nevertheless no time is to be lost. It should be remembered that the conditions which present similar symptoms are likely to be those of equal urgency such as obstructions of the bowel intussusception volvulus and the like so that the surgeon is fully justified in opening the abdomen immediately to find the source of the trouble.

## HIGH MORTALITY IN APPENDICITIS

Notwithstanding the real progress that has been made in the surgery of acute appendicitis and paradoxical as it may seem the figures of the United States census show a gradual but steady rise in the mortality from appendicitis since this century came in. This increase has been from 9.7 per 100 000 of population in 1900 to 15.2 per 100 000 in 1912. The figures given by Fitz for Massachusetts are very similar a death rate of 8.7 per 100 000 in 1900 had become 14.4 in 1900 000 in 1903. In 1900 only 243 cases in that state terminated fatally but in 1932 the number was 623.

In interpreting these figures we must of course bear in mind the fact that in 1900 the diagnosis of appendicitis was not so frequently or so properly made as is the case today. Many a

death certificate was undoubtedly labeled acute indigestion when the true cause of death was appendicitis. Yet the fact remains that the mortality from appendicitis is alarmingly high in view of our knowledge of the proper treatment of this disease.

It is the gangrenous or the gangrenous and ruptured appendix that accounts for this high mortality of appendicitis generally. For it appears that while the unruptured appendix has frankly yielded to modern scientific surgery when this is available an increasing number of afflicted appendices either receive no early treatment at all or are coaxed along by antiquated methods until the suffering organ has perforated. These cases account for the high mortality in appendicitis.

Reviewing 3 913 operative cases of appendicitis Finney in 1933 reported that in the 5 year period 1926-1930 inclusive 18.17 per cent of the patients concerned had ruptured before they came to operation—a statement that surely does not entitle us to feel much complacency. In his general peritonitis group of 240 cases there were 54 deaths a mortality of 22.08 per cent with danger multiplied by about 3 times over the success group (with 4.57 per cent mortality) and 215 times over the group of cases treated in an early stage. These figures were from a large group of cases cared for by family physicians and representing the average mortality.

In a study based on 220 cases Coudert in 1909 observed 7 deaths in the group of 20 patients with general peritonitis which thus represented a 35 per cent mortality in this class. Of Black & 14 fatal cases of acute appendicitis with local or general peritonitis no fewer than 7 (50 per cent) had suffered a ruptured appendix. Haggard had a mortality of 24.7 per cent from gangrene and Wilkie states that 90 per cent of deaths in appendicitis are in cases not of primary inflammation but of primary obstruction with resultant toxic gangrene and perforation.

As Labbé points out it is impossible during the first 12 hours to distinguish between those cases that will run a benign course and those that are destined to assume a graver form. Hence it is imperative to operate immediately upon making the diagnosis of acute appendicitis. Carried out at this time the operation is a simple and benign

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\* procedure, a precautionary measure designed to forestall an uncertain and unpredictable future. It is foolhardy to wait for more disturbing symptoms to force the surgeon's hand.

#### HOW TO LOWER MORTALITY

I feel that two avenues to lower this alarming mortality are open to us (1) the continuous and increasingly vigorous education of the public to the dangers of procrastination, (2) improved technical handling of the ruptured cases so as to save many of the patients who are now being lost.

With reference to the first of these needs, we all know that many patients with appendicitis resort to self-medication in the early stages of the attack, thus losing valuable time before the advice of a physician is sought. It is so easy to ask a druggist for something that will relieve a pain in the abdomen and to be given a sedative or more probably a cathartic.

The use of cathartics is especially objectionable. It was reported by Heyd that of 902 patients with acute appendicitis who took a cathartic, 1 in 14 died, of 992 who took two or more purges, 1 in 7 died, whereas of 402 who took no laxative, only 1 in 80 died. In Kehl and Rentschler's series of 126 cases, all but 2 of the 16 who died had been given cathartics, usually castor oil, before admission to hospital.

Too often the patient supposes that the pain in appendicitis must always be low down on the right side and so discards the thought of appendicitis because his pain is localized somewhere else. He does not know that delay may mean peritonitis and death. In some cases of insidious onset he may not even notice the earlier symptoms, may not be aware of anything more than a vague discomfort in the intestinal region and slight bowel disturbance, and thus fail to seek aid until the appendix has actually burst and peritonitis has arrived. Such cases are, to be sure, atypical. In cases in which the attack begins with acute pain, the patient is driven to the physician by his suffering. It is strongly incumbent upon the latter to impress the patient with the urgent necessity of hospitalization and early operation to avoid the complications that are almost inevitable with delay and the danger of possible death if a procrastinating course is pursued. Delay before operation must be recognized as the chief factor in the death of these patients.

But it is in the second of these avenues of approach to a lowered mortality that this paper is especially interested. Wherever improvements in operative technique and in the pre-operative and postoperative handling of the ruptured and

TABLE I—MORTALITY FROM APPENDICITIS AT GOOD SAMARITAN HOSPITAL (1931-1935)

	Cases	Deaths	Mortality percentage
<b>1931</b>			
Acute	335	11	3.1
Subacute	113	3	2.7
Chronic	201	2	1.0
Perforated	64	11	17.1
Total	736	27	3.7
<b>1932</b>			
Acute	304	14	4.6
Subacute	116	0	0.0
Chronic	191	1	0.5
Perforated	55	10	18.2
Total	666	25	3.7
<b>1933</b>			
Acute	340	11	3.2
Subacute	112	1	0.9
Chronic	162	0	0.0
Perforated	49	12	24.5
Total	663	24	3.6
<b>1934</b>			
Acute	379	16	4.2
Subacute	133	4	3.0
Chronic	152	0	0.0
Perforated	39	9	23.1
Total	725	29	3.9
<b>1935</b>			
Acute	400	16	4.0
Subacute	177	0	0.0
Chronic	143	0	0.0
Perforated	35	4	11.4
Total	757	20	2.6
Total number	3520	125	3.5

gangrenous appendix have been adopted, they are already bearing fruit in a lessened death rate.

With a view to showing the results that have been achieved by applying these newer operative methods at the Good Samaritan Hospital in Cincinnati, I have prepared the accompanying table, based on 3,550 cases of appendicitis taken from the files of that hospital and covering the 5 year period 1931-1935, inclusive. Table I records the number of cases of acute, subacute, chronic, and perforated appendicitis, together with the number of deaths in each category and the percentage it represents for each year and for the entire 5 year period. The incidental appendectomies done while operating for other conditions are not included.

It will be seen that the subacute and chronic cases carry a mortality of about 1 per cent. Wherever the appendix ruptured, the total mortality rose to between 11.4 per cent and 24.5 per cent, averaging about 18.9 per cent over the 5 year period, but with 11.4 per cent for its latest and lowest mortality figure for any single year, that of 1935. Under the chronic cases are included the interval appendectomies.

In my last series of 50 cases of perforated appendix in which the cecum has been decompressed at the time of operation the mortality for such cases has been only 4 per cent—a reduction of 13 per cent. Furthermore both deaths in the series were in cases in which patients had generalized peritonitis at the time of operation.

#### DECOMPRESSION OF CECUM

During the past 2 years we have made a number of modifications in the technique of appendectomy. Following removal of the ruptured appendix I have in a large number of cases inserted a Pezzer catheter into the cecum and recently I have been inserting it in practically every case of ruptured appendix. The catheter is introduced through the cecal opening after removal of the appendix and two fine linen purse string sutures are applied. A soft rubber drainage tube is carried into the cul de sac and another one is inserted into the iliac fossa to prevent secondary abscesses. These two drainage tubes are removed on the tenth day after operation. A clamp is placed on the distal end of the catheter in the cecum. This is removed from time to time to permit escape of gas or possible fecal material.

The main purpose of this cecal catheter is to permit decompression of the bowel before distention occurs with resulting paralysis. Willke has pointed out that there are two primary and fundamental processes which occur in appendicitis: one is the acute infection of the wall of the appendix; the other, an acute obstruction of the lumen of the appendix comparable to any other type of obstruction of the bowel. In the former the rise of temperature is natural and inevitable. But in the obstructive type this rise is absent during the early phase at the very time when diagnosis is all important.

While Willke does not agree that obstruction precedes infection in all cases, he does believe that blocking of the lumen with consequent tension is the real danger in appendicitis. In cases in which this factor is pronounced a cecostomy or enterostomy is indicated such as would be appropriate in any other type of intestinal occlusion. The distention hinders the circulation in the wall of the appendix which then loses its power of resistance. Relief of this tension by a cecostomy will accordingly render a service to the inflamed peritoneum by improving the blood supply.

This cecostomy opening however serves not only as an adequate valve for the escape of gas but also as an inlet for fluid to counteract dehydration. The Murphy drip is given at regular in-

tervals through the inserted catheter. It has the advantage of bringing fluid to just that part of the bowel where it can be best absorbed. This is far from true of the drip given by rectum where retention of fluid may be quite difficult in view of the natural excretory function of that organ. In the case of young children the cecum is a particularly practical point for giving the drip, avoiding wetting or soiling of the bed. The cecal fistula can also be used for the administration of enemas and for flushing out the bowel at intervals as may be required.

In the past many a surgeon has observed that the appearance of a spontaneous fecal fistula during the course of an appendicular peritonitis has resulted in almost immediate cessation of alarming symptoms and in marked improvement in the patient's general condition. A cecostomy drainage deliberately placed has the same therapeutic effect and in addition has a tendency when no longer needed to close spontaneously which is quite different from the behavior observed in an ordinary persistent fecal fistula. The catheter usually starts to drain within 24 hours and drainage continues for 4 or 5 days. After this the drainage from the catheter lessens and the bowels move naturally. The stay in the hospital in cases in which the cecum has been drained and in which no complications have arisen has averaged only 3 weeks and the fistula closes completely within a month. This outcome is unlike that of the spontaneous fistula which usually takes 6 to 8 weeks to close.

We do not claim that every patient with general peritonitis will recover through use of the method of decompression, but we do assert that it is becoming the usual thing to see patients recover who formerly would have died and the convalescence under these conditions is not nearly so stormy as it was under old methods. Dorance and Nealon report that they have used this method with excellent results in 30 cases securing effective decompression of the intestine by providing an outlet for gas and fecal material.

The question may be raised whether it is necessary to drain the bowel in every case of ruptured appendix. The answer is probably that it is not, but until we know on which ones to do an enterostomy and on which ones not to do so it is safer to employ the method in all. Formerly nature came to the rescue of these patients with a fecal fistula to relieve distention but she did so rather late or we did a secondary enterotomy also late when distention and frequently paralysis had already occurred and then it was too late.



In some of our cases we use continuous gastric lavage to supplement the cecal catheter in high obstruction or high ileus, where vomiting is persistent and the patient accordingly suffering with dehydration and loss of secretions from liver and pancreas, but this is not needed nearly so frequently as the cecal fistula. In order to rehydrate a patient who has lost essential fluids by vomiting, either gastric or duodenal lavage is instituted through the nasal catheter by the continuous method, as advised by Wangenstein. Intravenous or subcutaneous injections of glucose and chlorides are given routinely, and the Murphy drip is carried out through the cecostomy wound. In short, any method that will succeed in accomplishing the replacement of lost fluid is pressed into use, and it is astonishing to see how rapidly the prostrated and collapsing patient is restored to relative comfort by this restoration of fluid equilibrium.

#### INCISION AND DRAINAGE

As regards the type of incision for reaching the appendix, it seems to me that this is not so important as some surgeons would have us believe. There is very little difference between the point of entrance of the Kammerer, or outer right rectus incision, and the McBurney. The fact is that the McBurney incision extends to the margin of the right rectus and frequently overlaps the muscle. It exposes more raw surface to infection and does not permit cul-de-sac drainage as readily as the lower right rectus incision. This, in my opinion, is a disadvantage, especially when diffuse pelvic peritonitis is present. Secondary cul-de-sac abscesses are more frequent than is generally supposed.

We all agree, I think, that if a localized abscess is present, the incision should be so placed as to provide the best facilities for drainage. With the patient in the usual Fowler position after being put back to bed, the pus drains ideally by this method. We are absolutely opposed, with McGrath and Eiss, to the unsound practice of simply draining in the presence of localized pus and leaving the appendix alone. Some surgeons do this because they are afraid of spreading an infection that shows signs of walling off, or because owing to adhesions they cannot find the appendix. We feel strongly, however, that an operation for appendicitis that does not remove the appendix is only a palliative measure and invariably invites sequels, paving the way for stronger adhesions and more inflammatory and fibrous changes that will ultimately require renewed surgical measures of a more radical nature.

With proper caution, through a wide incision, the intestines can be packed off completely with moist pads, the plastic adhesions, usually not yet tough, can be carefully loosened, the pus can be aspirated, the appendix can be found and removed, and the cavity can then be thoroughly cleaned out and closed, with or without drainage according to the individual case.

#### RELIEF OF DISTENTION

We are convinced that the peritoneum can take care of extensive infection even in presence of general peritonitis, *provided the bowel does not become distended*. It is distention that we have to fear more than infection, for distention impairs circulation in the gut walls and leads more quickly than anything else to gangrene. We find Wilkie insisting that blocking of the lumen with tension is the real danger in appendicular disease and advocating cecostomy or enterostomy according as the large or the small bowel is more affected. Such relief of intra-intestinal tension will, among other things, render a service to the inflamed peritoneum by permitting a more efficient blood supply.

With the source of infection removed, the peritoneal cavity is generally capable of taking care of itself, say Wilks and Mora. Consequently, with the ruptured and gangrenous appendix out, they regard drainage of the cavity as unnecessary. They believe that it does not subtract from the mortality but, on the contrary, adds to the morbidity. A study of 100 cases convinced them of the comparative safety of closing the abdomen without drainage in acute suppurative appendicitis.

Haggard has seen gangrene present as early as 6 hours after the first symptoms of appendicitis and states that it usually develops within 24 hours, again supporting the view that it is obstruction of the lumen of the appendix that causes the fulminating cases in which the patient is gravely ill from the start with agonizing and continuous pain and persistent vomiting. This indicates what is to all intents and purposes an intestinal obstruction, ending in death of the appendix with almost certain gangrene and perforation unless promptly operated on. But when the distention is relieved, the peritoneum has strong resources within its own circulating blood for combating the infection.

When the peritoneal cavity is found full of free pus, this should be carefully aspirated, never irrigated as was done of old. Irrigation only serves to disseminate the infectious material. Modern surgery has renounced this method and concen-

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uates on a search for the offending appendix after removal of which the surgeon more at his leisure may seek out and drain any secondary or aberrant collections of pus which may some times be at a distance as for example in Douglas cul de sac under the liver or in the left iliac fossa.

Apparently the difference in the amount of distention is the reason for the differences observed in the rapidity with which appendicitis brings on a diffuse peritonitis. Twenty four hours in one patient will do as much mischief as 3 days in another. Some patients have a generalized infection in a single day while others within the span of a week have little more than a lymphatic exudate around the appendix. Too many unknown factors exist however to make it permissible to postpone operating under any circumstances.

Let me emphasize again that loss of time when the patient is in a state of distention is the chief cause of the mortality from ruptured appendix. To save time must be the primary consideration. The patient is absorbing toxins the circulation of the gut is obstructed death is imminent.

When a patient presents symptoms of appendicitis no matter how mild the only safe course to pursue is that of immediate hospitalization and prompt operation for the removal of the appendix. Delay leads fatally to those dangerous complications with gangrenous and finally ruptured appendix with distention from obstruction of the lumen and impairment of local circulation all too frequently terminating fatally within the span of a few days or even a few hours. No surgeon can ever know at the outset whether the case presenting itself is going to be one of these fulminating cases. I am accordingly convinced that prompt removal of the appendix and relief of distention by cecostomy are the only means by which the surgeon can do justice to his patient. The results in reduced mortality after use of this method bear eloquent testimony to the validity of this point in view.

## CONCLUSIONS

- 1 It is the gangrenous or the gangrenous and ruptured appendix that accounts for the high mortality of appendicitis

2 Improved operative technique in handling ruptured appendices will save the lives of many patients

3 Death in cases of ruptured appendix is due more to distention from intestinal obstruction than to infection of the peritoneal cavity

4 The peritoneum can successfully withstand extensive infection even in cases of general peritonitis provided the bowel does not remain distended

5 Relief of distention by placing a decompressive cecostomy following appendectomy is indicated in all cases of ruptured appendix

6 Results of decompressive treatment warrant the belief that a greatly lowered mortality rate will follow the increased application of the method

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## TREATMENT OF FRACTURES

## FURTHER OBSERVATIONS ON THE USE OF SPLENIC EXTRACT

THOMAS WHEELDON, M D, RICHMOND, VIRGINIA

THE idea of a splenic extract diet was suggested by the work of Otto Fliegel who fed raw spleen to patients with bone and joint tuberculosis. The present paper is the outcome of this idea and its development, for the question very soon arose whether, if splenic extract treatment can be used in tuberculosis of the bones and joints, why not in fractures (new and ununited), in osteomyelitis, and in rachitis?

In 1933, the writer<sup>1</sup> described the use of splenic extract in the treatment of bone and joint tuberculosis, over a period of 2 years. The results were summarized as follows

1 The use of splenic extract in the diet of patients suffering with bone and joint tuberculosis has been found very beneficial, as improvement is noted in the febrile condition, the local reactions, the growth, the weight, the color, the appetite, the blood composition, the deformity, the complications, the roentgen picture, the activity permissible to the patients and the dispensing with support

2 Improvement from splenic extract treatment probably will be more apparent to those who are unable to enforce a strict compliance with the accepted ideal treatment, i.e., support, recumbency, heliotherapy, proper feeding and proper aeration

3 The production of splenic extract is possible and the distribution is practicable

4 It is possible to obtain the co operation of patients in adopting the splenic extract diet, even of those in remote sections

5 Splenic extract treatment has also produced improvement in osteomyelitis (acute and chronic) and in ununited fractures. This investigation is well under way

6 Enough improvement has been shown in the blood composition to stimulate further study of this phase

7 The writer cannot explain the improvement gained by the administration of splenic extract. Various explanations given so far may all be true, but these investigations lead to the belief that as yet there is no certainty as to which is the most important factor

While the report of Barr does not confirm this, he has been good enough to leave the matter open. The writer explains Barr's opinion first upon the basis that Barr carried out the splenic extract diet only for 6 months, which is not a sufficiently long time, and second, upon the fact that Barr's patients were already receiving such superb treatment (Peabody Home, Boston, Massachusetts) that the small degree of improvement possible was hard to ascertain, while the writer's cases were collected from a group in which the excellent treatment of Barr was impossible. Hence, the

improvement gained by him by splenic extract diet was very evident

The late Dr Eikenbary through his associate, Dr John F LeCocq and assistant, Dr J N Nelson, duplicated the work of Barr and of the writer, and their results would appear to confirm those reported by the writer

In 1933, I was unable to explain definitely why these cases of bone and joint tuberculosis improved under the treatment with splenic extract but at the same time I had noted improvement in acute and chronic osteomyelitis and in ununited fractures. As there is calcium deposition in the healing of bone and joint tuberculosis, and as this is also the case with acute and chronic osteomyelitis and ununited fractures, the work of ununited fractures was pushed along as a definite investigation, with the idea in mind of the probability of being able to work out a solution of the physiological action of the splenic extract. And from this investigation the writer now feels that he can make some deductions

The present paper is designed to show the effect of splenic extract diet upon the healing of fractures. Among the 45 cases which he is reporting here, there have been 3 failures, and all three of these failures fall in the series of cases in which bone grafts were performed. Two of these were fractures of the femur, with massive grafts, and 1 was a fracture of the humerus with a massive graft. In 1 case it is impossible to explain the non-union of the fractured femur on any grounds. The case of fracture of the humerus had been operated upon originally by some one else and was understood to have had an infection of the previous graft. One case of fracture of the femur, operated upon by the writer, with a massive graft, had an infection as a result of an old compounding of the fracture which had been healed for a year and was therefore considered by the writer to be quiescent at the time of the operation. It is interesting to note, however, that in spite of the fact that union did not take place completely, the graft did unite so solidly to the proximal end of the distal fragment that at the time of a second operation, the graft had grown so firmly into the proximal end of the distal fragment that the cleavage line could not be found, and it was impossible to remove the original graft. The graft was therefore cut off

<sup>1</sup> Bone & Joint Surg 1933 April

evenly with the proximal end of the distal fragment and the distal portion of the graft was left completely ingrown into the proximal end of the distal fragment. This would lead one to believe that the splenic extract diet had helped to a great extent and that another factor probably the infection was wholly to blame for the persistent non union.

The problem was attacked very cautiously and splenic extract was used at first only as an adjunct. In other words it was used only to supplement the other procedures in the treatment of ununited fractures. The first series of cases consisted of those in which bone graft operations were performed. In this series of cases—8 in number—it was found that not only did union occur more quickly and more firmly than would ordinarily have been expected but the condition of the bone as a whole was improved. In Case F 1 S V 2 the cortex of the bone at the time of the operation was found to be of only egg shell thickness. It could be cut with an osteotome almost by pressure of the hand alone without a mallet. Not only did union take place but in 60 days the degree of union was unusual and in 95 days (14 weeks) union was perfectly solid. In Case I 2 S V 2 because of the result already experienced in several cases it was decided to abandon the mass use of graft and to use only a small graft to hold the ends of the fragments of the femur in apposition. Due to poor facilities even the position was not perfect but in spite of this a mass of calcium was deposited so great that the writer was thrown into confusion. The conclusion that splenic extract induced an unusual deposit of calcium now seemed unavoidable.

The second series of cases—12 in number—was begun then. Fortunately at this time the writer had a considerable number of fractures in which the position of the fragments was good although lack of union had persisted from 7 to 12 months. This group consisted of cases that were treated by the administration of splenic extract and the use of crutches alone. No other treatment was instituted as in these cases other procedure had been exhausted. The serial roentgen ray films of Cases F 3 S V 2 F 4 S V 2 I 5 S V 2 and F 6 S V 2 speak for themselves.

These observations seemed to encourage the writer in the inference that the administration of splenic extract did stimulate the deposition of calcium. A third series was then started. This series consisted of 10 cases which had been referred to the writer of fractures united more or less in bad position after a duration of time (3 to 4 months). Following the proper reduction of these fractures

the patients received splenic extract. While it is true that following the proper reduction of fractures which have been in malposition for some time in which there is little union healing is expected with this procedure of reduction alone. Case I 7 S V 2 illustrates the writer's point that the deposition of calcium following reduction in those patients treated with splenic extract diet is more advanced than in those patients without the diet and by comparing the rapidity of the calcium deposition between the time of the fracture and the reduction (8 weeks during which no splenic extract was administered) and the deposition between the reduction and the time the postoperative film was taken (4 weeks during which time the patients received splenic extract) the comparative increase can be noted.

The fourth series consisted of 1 case that of a white girl 14 years of age with fragilitas osium. This patient had received every known treatment by leading men throughout the world without avail and in addition osteotomies performed for correction of deformities in the past had not healed when she was brought to the writer in spite of the fact that the osteotomies had been performed some years previously. Upon the splenic extract treatment not only did the general condition of the bones as a whole markedly improve but the non union present definitely became solid clinically and also improved roentgenologically. This case is especially important in that the calcium and phosphorus balance showed a retention of calcium before treatment of 0.235 and a retention of 1.10 hours before treatment of 0.259 and following treatment with splenic extract over a period of six months showed a calcium retention of 0.110 and a phosphorus retention of 0.945. The calcium phosphorus balance had been run in other cases (Table I) of the 45 which comprised the total group but this is the only illustrative case in which the calcium phosphorus balance was run and it seems to confirm the writer's findings that calcium deposition is stimulated by the splenic extract. When this patient was first seen by the writer he could hardly walk at best waddling with a crutch using two special crutches. At the present time she rides horse back and is entirely independent. The cases are being continued as a protective agent only.

The fifth series of cases was that in which fresh fracture cases were treated with splenic extract. There were 14 of these cases. Case F 9 S V 2 indicates the unusual activity of union.

It was now felt that it had been proved clinically that splenic extract does forward the healing of fractures. The problem of animal experi-

mentation was next approached. Four dogs of the same sex, breed, size, and weight were chosen. These dogs were from separate litters. One femur each of two dogs was osteotomized, and 1 tibia each of 2 other dogs was osteotomized, by open operation. The wounds healed in each case by first intention. No splints were applied. One of the 2 dogs whose femora were osteotomized and one of the 2 other dogs whose tibiae were osteotomized were put upon the splenic extract. The 2 other dogs were fed a regular diet without spleen. Clinically the union of the fractures in the dogs upon the splenic extract diet was very much more rapid and firm than the union in the dogs which were not fed splenic extract. At the end of 69 days (9 weeks), all dogs were killed and a block of tissue taken through the fracture line of each of the specimens. The histological report of the pathologist is quoted as follows: "These specimens, all blocks of similar size, were placed in decalcifying solution (strong formaldehyde 10 c cm, distilled water 90 c cm, nitric acid 20 c cm). From time to time I tried specimen No. 1 to determine the degree of decalcification. When decalcification was complete in No. 1, the tissues were all washed free of acid and again placed in 10% formaldehyde. Much to my surprise and chagrin I found, when I started to make the sections, that specimens 1 and 3 were properly decalcified while specimens 2 and 4 were so digested by the acid that good sections could not be made. Specimen No. 1. The periosteum is thickened and consists of an outer dense layer, a thickened fibro-elastic layer and a thin osteogenetic layer. Bud-like processes of the osteogenetic layer are growing inward from the periosteum. A calcified matrix forms irregular indented tapering processes. In most areas there is seen a layer of bone-matrix upon the surface of these trabeculae. Spaces between these processes are filled with marrow containing principally fat and erythropoietic tissue, with a small amount of myeloid tissue and blood vessels. The picture is that of the well advanced development of spongy bone. Specimen No. 3. The picture is the same as that of specimen No. 1, but bone development seems more advanced, i.e., there is more bone matrix. In fragments Nos. 2 and 4 studied, there seemed to be very little bone formation and this was unsatisfactory. I would judge that there was less also from the reaction to the decalcifying solution." Signed Regena C. Beck, M.D., Pathologist, Stuart Circle Hospital, Richmond, Virginia.

<sup>1</sup> Author's note.—By this the pathologist means the decalcifying solution decalcified the specimens from the dogs which did not receive splenic extract many days before it decalcified the specimens from the dogs which did receive splenic extract.

Specimens Nos. 1 and 3 were those from the dogs which received splenic extract in their diet. Specimens Nos. 2 and 4 were those from dogs which did not receive spleen in their diet. Both from the microscopic examination and from the time of decalcification in the decalcifying solution it is evident that union in the dogs with splenic extract diet was better than that in the dogs without the splenic diet.

From these findings it is felt that it can be definitely said that the administration of splenic extract in the diet forwards the healing of fractures. This opinion is based upon the clinical findings in fractures (new and ununited) in the human, the roentgenological findings and the results of the study of the calcium phosphorus balance in the human and the clinical and histological findings in experimental animals (dogs). All of these points are covered in this paper.

And moreover I also believe that light is shed on the physiological action of the spleen. I have clinical, roentgenological, laboratory and histological evidence that splenic extract which is taken orally induces calcium deposition in the callus of fractures if it does not actually stimulate the formation of new bone (and the writer has evidence which strongly influences him in this belief).

#### Quoting Miwa

Dubois Raymond once said that the spleen is an unexplainable organ. His word holds good even today for the functions of the spleen are so diverse and so indefinite that although so many scholars have reported their findings about this organ, nevertheless, of their theories have so far been generally accepted. Or late years however the belief that the spleen may be an endocrine organ has steadily gained ground, but little experimental evidence has been offered to support the view that the spleen is an active endocrine organ. Dominici, Pei Port, Pearce, Nathan, B. Eddy, Davis, Adrey and Nathan, B. Eddy, Julius Mayor and Moncorpe, Belah and Saghi, Elex Bruceman, Hirschfeld, Hans and Walter Fabisch, S. G. Sakharoff, Toda, Oda, Hamazaki, In Ichirun, Niomiya, Onashi and Waterface, Stchedrovitsky and Munkov and Lopatin, Stchedrovitsky and S. A. Seltzen, Faras and Tangle, Inamura, Toarumitsu and Toyoda and others have all commented on the subject. Their theories, however, are chiefly based upon such clinical symptoms as collapse after splenectomy or upon biological experiments with splenic substances and only those published from our laboratory, are based on experiments such as removing and transplanting the spleen in series of animals. In order to prove convincingly that a specific organ is endocrine, it is not only necessary to carry out such experiments as the above but it is also important to ascertain whether or not there is a splenic substance in the lymph stream or in the venous blood that would carry out any secretion or excretion from that organ, and, if there is to observe how far this substance can control definite symptoms that develop after the removal of the organ. If such a substance exists it should be chemically isolated. The present studies have been carried out on this principle, and I have some significant facts to report.



Fig 1

Fig 2

Fig 1 Case 1 Un union of tub. d. f. b. l. at the end of month. Not the title is practically the end of month. Not the title is practically the end of month.

Fig 2 Case 2 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.



Fig 3

Fig 4

Fig 3 Case 3 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.

Fig 4 Case 4 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.

His (Miwa's) experiments showed that increase of splenic hormone causes decrease of serum calcium. Splenectomy causes increase of serum calcium.



Fig 3

Fig 4

Fig 3 Case 3 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.

Fig 4 Case 4 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.

Fig 5 Case 5 Roentgenogram taken 7 weeks after bone graft and plate. The time was 17 days. Tibial union is complete. Tibial union is complete.

increase of parathyroid hormone causes increased serum calcium and removal of parathyroids produces a fall in serum calcium. The increase of thymus hormone produces a fall of serum calcium and a decrease of thymus hormone produces an increase of serum calcium. While the writer has found no change in serum calcium upon the administration of splenic extract orally, the change in the calcium phosphorus retention definitely shows that there is an effect upon the calcium in the tissues (Table I). The calcium phosphorus retention studies bear out the roentgenological and histological studies that calcium is deposited.

Referring back then to the healing of fractures the writer does not believe that the administration of spleen will make all fractures heal but in the absence of other cause of non union he does believe the administration will help in a majority of cases to produce union and that the cause of non union in such cases is probably a low calcium phosphorus retention, if not actually a negative one. He also believes that the cases of tuberculosis of the bones and joints and cases of osteomyelitis that do not do well, other things being equal, have a low calcium phosphorus retention that they will improve on splenic extract diet and that they do this because of the stimulation of calcium retention in the tissues.

Table I represents the effect of splenic extract diet upon the calcium and phosphorus retention in 3 cases. Of these 3 cases Number 3 represents

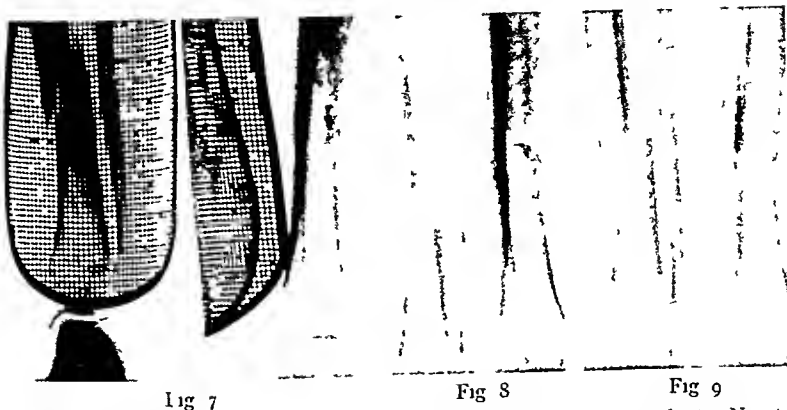


Fig 7

Fig 8

Fig 9

Fig 7 Case 4 Roentgenogram taken 7 months after original accident No attempt at healing

Fig 8 Case 4 Roentgenogram taken 11 weeks after splenic extract treatment was started

Fig 9 Case 4 Roentgenogram taken 13 weeks after splenic extract treatment was started Union is obviously very firm

TABLE I

	Calcium retention		Phosphorus retention	
	Before	After	Before	After
1	0.484	0.879	0.437	0.860
2	0.109	0.790	0.168	0.818
3	0.235	0.770	0.259	0.945

Case F 8, S V -2, of the series described above. The 3 cases whose calcium retention and phosphorus retention are given are cases of non-union, and it would appear that the retention in these cases was low and that it approached the normal under the splenic extract diet. It is entirely possible that this is the type of non-union case that the splenic extract diet will help most, and again it is possible that the non-union in these cases may be explained by the low calcium-phosphorus retention.

CASE F 1, S V 2 Male, white, 64 years of age. Patient had ununited fracture of tibia and fibula, left, duration of the non union 11 months. When patient was seen by the writer, he was using a walking splint which he had been wearing for 5 months. Roentgenogram at this time showed no attempt at union in the tibia or fibula. Physical examination was negative. Complete laboratory work, including all blood chemistry, was carried out in this case, and nothing abnormal was found. Patient was put upon splenic extract diet immediately after operation, which consisted of a massive sliding bone graft of the left tibia. He wore a plaster cast for 7 weeks, at which time union was very solid. Splenic extract diet was continued for several weeks following this, as patient seemed to have a definite calcium deficiency of the bones.

Important points in this case are that at the time of the operation, the cortex of the tibia was found to be of egg-shell thickness. Union took place in 7 weeks, and upon the splenic extract diet in a few weeks following this the tibia had

regained an almost normal appearance in the roentgenogram, indicating definite calcium deposition. This patient was followed by the writer for a period of 10 months.

CASE F 2, S V -2 Female, white, 15 years of age. Patient had an ununited fracture of the femur, right, for 1 year. Roentgen ray examination showed only a slight attempt at union of the fragments. Physical examination was negative. Complete laboratory investigation was carried out upon this patient, and it was found not to have been altered materially. Following the operation, patient was immobilized in a plaster spica and splenic extract diet was started. Plaster was removed altogether in 3 months, with good union. Union was so solid that it was safe to manipulate the knee 4 months after the original operation in order to break up adhesions which had formed from long immobilization during her long non-union. Splenic extract was continued for 5 months.

Important points in this case are that with only a small intramedullary graft to hold the fragments in position, firm union immediately took place, and in addition there was a very startling calcium deposition about the site of the fracture, as will be seen in the roentgen-rays. This patient was followed by the writer for a period of 13 months.

CASE F 3, S V 2 Male white, 29 years of age. Patient had ununited fracture of the tibia and fibula, right, for 1 year. Roentgen ray showed practically no attempt at union. Physical examination was negative. Union began 3 weeks after splenic extract diet was started and continued progressively without retrogression. The patient went back to work, doing full farm work, 3 months after splenic extract diet was started. Splenic extract diet was continued 3 months.

Important point in this case is that the healing of the fracture, after the beginning of the splenic extract diet, was almost perfectly serial, as will be

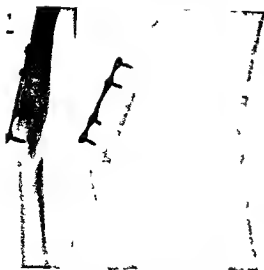


Fig 14

Fig 15

Fig 14 C. K. tg gram tlen m th ft  
fra tu sh s malpo t n fract th g t d al  
f d t r s (lat c firm d t per t) d r y l t l e  
ll

Fig 15 C se 7 Roentgen m t k 4 ek ft  
p to d t art g f spl n e f c t t m t H l  
g app st be qu t

Fig 14 C

Fig 15

light alu m plant h ferred to th t Ph y l  
exam ton w n g at e C m p l t e l b o t o r y t g  
t sea r d t u p th a s d t s f d t t  
h e b e e l t e d e c p t t h a h a d l g t f l l t h  
the blood g from 98 m l l g r m s to 96 m l l g m f  
t at a p t p o p l e t a c t d e t n d f m t h  
th d w k h e a l g f t h b o n e d e f i n i t l y b e g n d  
t t n d t h o t b a t m e n t l n a p r o d f l s  
r y s o l d n d p t t b g t l k t h t s p p r t

een from the roentgen rays Patient was fol  
lowed by the writer for a period of 6 months

Cas 14 S V F m l w h t 24 y f g e l a  
t e t h d n t d f t u r f i b d n h l a g h t f o r  
p e o d f y m t h R o e t g e 3 s h d i t t l t  
t m p t t h l g f t h b o e l t t h a d b e m m b l i z e d  
p l s t f s l m t h b t g n l y



Fig 16

Fig 17

Fig 16 C. K. tg gram tlen m th ft  
fra tu sh s malpo t n fract th g t d al  
f d t r s (lat c firm d t per t) d r y l t l e  
ll

Fig 17 C se 7 Roentgen m t k 4 ek ft  
p to d t art g f spl n e f c t t m t H l  
g app st be qu t

In this case without treatment of any kind be  
sides splenic extract the bones began to heal 3  
weeks after the beginning of the splenic extract  
diet and continued to full union Patient was  
followed by the writer for 13 months

CASE F5 S V M l h t 95 c s f a g P t t  
h d a t d f t u f t h f m l t f r p e o d f  
3 e R o e t g y h e d p r a c t c l l y n o t m p t t  
n P h y t m t s n g t C m p t t  
l b o t r y t g t m r r e d t p o t h s e  
d t w f d t t o h b e e n l t d g t f  
l g h t u s e t h b l d g f m 94 m l l g m t 98  
m l l g a m s l t t p t p o p l t d t f s  
p e r o d f 3 k S o l d n e s l e d t h p t t s  
f l l d f p e r o d f 3 e k

C 26 S V f m a l h t 93 s f g f  
t t h d a n t d f t f t h n e c k f t h f m  
g h t d t m t h R o e t g n y e m n a t  
h w e d p r a c t c l l y n o t m p t t h l g f t h f a c t u e  
t h p p t l y l g a d t e o m y l t f t h e c k f  
t h f m J h y c a l m t s g a t C m p t t  
l b o t r y t g t m r r e d t t h c a s e d  
p t f s e f t h l l h o d l l f m 343 o o o t  
44 o o o t h i s e t h l m g l b f r o m 74 t



88 per cent nothing abnormal was found. The white blood cells fell from 15,000 to 9,000. Patient was put upon a splenic extract diet, when healing began almost immediately, and was very satisfactory in 14 weeks.

In this case not only did the fracture heal under the splenic extract diet, but the low-grade osteomyelitis present also apparently cleared up. This patient was followed for a period of 14 weeks.

CASE F 7, S V -2 Male, white, 42 years of age. Patient had a fracture of the femur, right, 2 months old, which had remained in malposition during this period of time. Roentgen ray examination showed very little attempt at union. Physical examination was negative. Complete laboratory investigation was carried out in this case, and no alterations were found. The patient was operated upon and splenic extract treatment started at once. The healing of this bone was very remarkable, as can be seen in the roentgenograms. Union was very solid in 7 weeks. Patient was continued on splenic extract treatment for a period of 12 weeks.

In this case at the end of 4 weeks the healing of the fracture was very unusual. Patient was followed by the writer for a period of 14 months.

CASE F 8, S V -2 Female, white, 14 years of age. Patient had fragilitas ossium, with ununited fractures of the neck of the femora. This patient had had the ununited fractures for a good many years. She has been all over the world, spending a year with Rollier, in an attempt to get the fractures healed. Physical examination was negative. Complete laboratory investigation was carried out upon this case, and it was found not to have been altered except in the important increase of calcium and phosphorus retention. The calcium retention increased from 0.235 to 0.770, and the phosphorus retention increased from 0.259 to 0.945. Patient was put upon splenic extract diet, and 6 months after its beginning not only had there been very marked deposition of calcium in all of her bones, but the non union clinically had disappeared and from a roentgenological point of view was very much improved.

In this case healing of fractures, ununited for years, took place under the splenic extract diet, and the condition of the bones characteristic of fragilitas ossium improved. Patient was under the writer's care for 10 months.

CASE F 9, S V -2 Male, white, 14 years of age. Patient had a fracture of the femur, left. Physical examination was negative. Immediately after the fracture of the femur had

been reduced, patient was put upon splenic extract diet, and 12 days after the institution of the splenic extract diet the healing of the fracture was quite remarkable.

In this case the splenic extract diet hastened healing to a point in which fracture of the femur in a child of 14 years of age could be considered moderately firm at the end of 12 days. This patient was kept on a splenic extract diet for a period of 12 weeks. Patient was under the writer's observation for 5 months.

#### SUMMARY

- 1 Splenic extract diet would appear to hasten the healing of fractures, both fresh and ununited.
- 2 Splenic extract diet may induce an increased calcium retention which might explain at least one of the functions of the spleen.

Grateful acknowledgment is made to the following: Rolland J. Main, Ph.D., assistant professor of physiology and pharmacology, Medical College of Virginia, who assisted with the animal experimentation; C. Paul Reed, M.D., of the Indiana (Pa.) Memorial Hospital, who kindly collected data upon 2 cases for the writer; C. Braxton Valentine, biochemist of Valentine's Meat Juice Company, Richmond, Virginia, who generously furnished the material used in these studies.

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## ELONGATION OF THE PARTIALLY CLEFT PALATE

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**I**n the repair of cleft palates one goal should be to obtain the best possible function of the soft palate. This will require pliable tissue sufficiently long to meet the posterior wall of the pharynx (Passavant's pad) in the sphincter-like action of this region that closes the opening between the nose and throat. Although operations may be well executed and the palates may appear normal after operation, it is extremely exceptional that perfect speech is obtained. This persistent speech defect is probably due to a leak of air into the nose which may occur if there is an opening left of only a millimeter.

In efforts to insure complete closure, methods have been described for gaining length in the palate or for carrying the posterior pharyngeal wall forward. These procedures have been completely summarized by Dorrance in *The Operative Story of Cleft Palate* and need only mentioning here.

Elongations have been done by freshening the edges of the posterior pillars, detaching them low down in the pharynx and then suturing them together in midline, thus extending the palate behind the uvula. This has effected good results in many cases, but tissue that is normally a tensor of the palate is changed around so that the levators pull it up in closure of the opening. Blair has put rectangular flaps from the cheeks across the palate after it has been dissected backward, but the procedure is somewhat formidable for the gain involved. Gillies and Fry have described a backward dissection of the palate with an apparatus to hold a skin graft on the raw surface. The resultant opening into the nose in the front part to be closed by an obturator.

Some think that in complete clefts an operation of the Dieffenbach principle may be executed to allow moving backward of the entire palate, but if any great displacement is done a hole persists in the front part of the palate. Others have even sacrificed the closure in front in order to have the tissue available posteriorly and have then used obturators for the anterior opening or have brought in flaps from a distance.

After closure of the palate, several surgeons have directed their attention to carrying the posterior pharyngeal wall forward by reefing it forward by the use of a submucosal plicature and by rectangular mucous flaps dissected free

from the pharynx and attached to the soft palate (Ladgett and Wardhill). Any of these measures, especially the reefing forward of the posterior wall, can be added to this procedure if the operator so desires.

Palates that are cleft only through the soft tissue or on up part way through the bone may have actually less tissue for repair of the soft palate than those with complete clefts, and there are also patients with uncleft palates that are so abnormally short that speech is just as bad as though the palate were cleft. Dorrance has called this congenital insufficiency of the palate. It is in this group that the most direct attempts have been made for actually lengthening the palate by moving the whole of the soft tissue backward and still having the bony palate in front to separate the nose and the mouth. Dorrance's procedure which he calls the "push back operation" is probably the best known. The essentials are that a delayed flap of the entire covering of the bony palate is made except that the major palatine arteries are sacrificed. At a later operation the muco-periosteum is again raised from the bone and the whole mass is pushed back so that the anterior edge of the flap may be anchored as far back as the posterior bony edge. The cleft is closed and the anterior denuded bone is left to heal over.

#### AUTHOR'S TECHNIQUE FOR LENGTHENING THE PARTIALLY CLEFT PALATE

Our interest in the problem of obtaining the longest possible palate has fluctuated with the results obtained with various procedures, but since September, 1931 (after Dorrance's first report of his technique) we have used the procedure outlined here. The principle is that a direct flap of practically the entire palate is raised completely free from the bone and is immediately set back so that the anterior free edge is anchored clear back at the posterior edge of the bone. The major palatine arteries are meticulously preserved and left to supply the palate flap. The palate is allowed to heal here, the bony palate to cover completely with epithelium and at a second operation the palate cleft itself is closed.

**First operation.** An incision is made across the surface of the anterior pillar over the ramus and into the maxillary tubercle. It is then carried

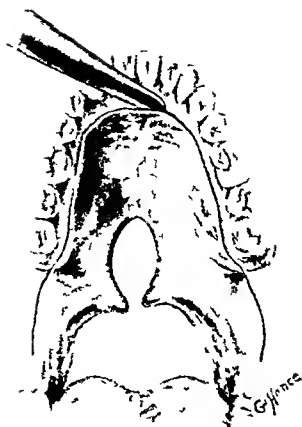


Fig 1

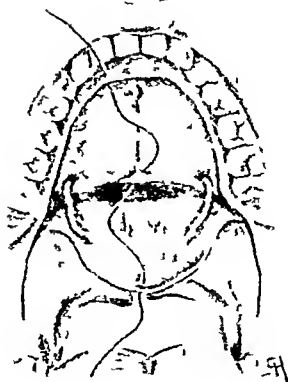


Fig 2

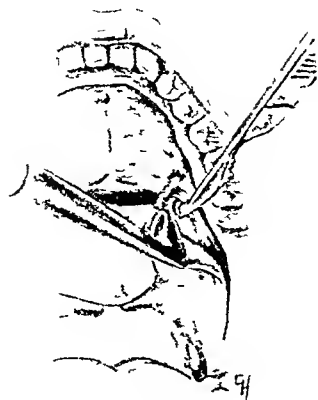


Fig 3

Fig 1 Line of incision and beginning elevation of mucoperiosteum

Fig 2 Diagrammatic representation of palate completely detached from bone, both major palatine arteries intact, and preservation of a band of nasal mucosa to

which the palate is attached with the first suture as shown

Fig 3 Detail diagram of deep separation of the soft tissues, exposure of the hamulus, freeing of the palate aponeurosis in this area behind the artery, section of the tensor tendon

entirely around the palate against the alveolus and out over the opposite side (Fig 1)<sup>1</sup>

An elevator is used to detach the mucoperiosteum completely from the bone, and the arteries are carefully preserved. When the posterior edge of the bone is reached, the nasal mucosa is carefully opened and a narrow edge is left attached to the bone to be used for the anchoring sutures that are put in later (Fig 2). The elevator is put behind the arteries and the space down to the hamulus and pterygoid plate is opened so that the surface and deep soft tissues throughout the entire extent of the incision may be freely mobilized. The tensor muscle may be divided at the hamulus and the dissection of the aponeurosis from the posterior edge of the bone is completed so that the entire mass of palate tissue is held by the remaining uncut surface over the pillars, the major arteries and the levators. At this stage, in spite of the very free dissection, it is interesting to note that the levators are still active (Fig 3).

The arteries are then elongated by carefully stretching them from their foramina and slightly separating them from the raw surface of the palate. We are convinced that this procedure can be successfully carried out as we have done it throughout this series, and we do practically the same thing in repairing total clefts.<sup>2</sup>

When the palate is quite free and movable the anterior cut edge is sewed clear back at the posterior bony edge, being anchored, with a horsehair suture, to the little flap of nasal mucosa that is left attached here. The lateral free edge of the flap is then anchored at the maxillary tubercle on each side and one or two more sutures may be inserted (Fig 4).

The tissue is usually somewhat humped up, but it is definitely longer and the halves of the soft

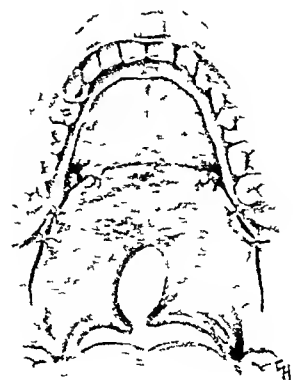


Fig 4 Completion of first stage. The palate has been set back and anchored with horsehair sutures as shown. Several layers of iodoform and balsam of Peru gauze are placed smoothly over the exposed bone and will be retained without sutures for several days.

<sup>1</sup>All illustrations are diagrammatic, drawn as though the palate were viewed from below instead of through the open mouth.

<sup>2</sup>Blair, V. P., and Brown, J. B. "The Dieffenbach-Warren operation for closure of the congenitally cleft palate." *Surg. Gynec. & Obst.* 1934, 59: 329-330.

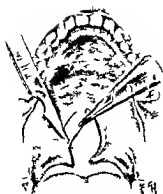


Fig 5

Fig 5 Beginning of second stage. The incision is made in the soft tissue of the palate up to the plate. The distance between the incision and the plate is 2 millimeters.



Fig 6

Fig 6 A distal stay is used to hold the plate in place. A good block of tissue may be left to do the

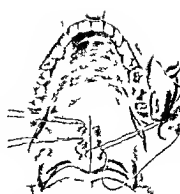


Fig 7

nasal reflex it may be of also bled in the land brought to the mouth. Extra material may be put in the soft tissue of the palate etc. in the soft tissue of the palate. The distance between the incision and the plate is 2 millimeters. The distance between the incision and the plate is 2 millimeters.

palate may be lying in contact with the posterior wall. The anterior defect is covered smoothly with a pack of balsam of Peru and iodoform gauze and no sutures are necessary to retain it.

If indicated a tonsillectomy and an adenoidectomy is done at the start of this operation.

Recovery is usually prompt and the patient can

leave the hospital in 3 to 7 days. The pack is removed about the sixth day and repacking is occasionally necessary for bleeding.

Complete healing of epithelium over the bony palate occurs in 20 to 30 days and is practically normal in appearance except that rugae are not present. At this stage the soft tissues may be somewhat humped up from side to side just behind the edge of the bone. The actual lengthening might be said to be the difference between what tissue is used in this humping up and the total distance the edge is set back. This distance may be as much as 2 centimeters and is the space between the anterior incision to the posterior edge of the bone. Improvement in speech is usually already noted even though the cleft is not completely closed.

**Second operation.** The cleft in the palate is closed as desired either by simply freshening the edges and suturing them or by first undermining through new lateral incisions to gain any necessary mobilization (Figs 5, 6 and 7). This stage may frequently be combined with the first stage so that only one operation is necessary.

#### RESULTS OF TREATMENT AND QUALIFICATIONS OF THE PROCEDURE

By this time I had hoped to report on more patients; however, over the 5 year period observations even in this small group may be worthy of evaluation.



Fig 8 Complete distal stay placed in the soft tissue of the palate. The distance between the incision and the plate is 2 millimeters. The distance between the incision and the plate is 2 millimeters.



# LOCALIZATION AND EXTRACTION OF FOREIGN BODIES WITH THE AID OF COLORED ROENTGEN OPAQUE OIL<sup>1</sup>

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In civilian practice no surgeon has the opportunity to acquire expert skill in the localization and extraction of foreign bodies. He is, however, expected by the laity to be able to remove a foreign body from an extremity at one operation and with ease. A failure to do so at one operation is damaging to surgical reputations.

It is evident that most civilian hospitals are not likely to be equipped with elaborate x-ray surgical tables designed for this special purpose or that the surgeon who is called upon only occasionally to remove a foreign body will familiarize himself with the double image or the intersecting axes method of visualization or such instruments of precision as the Hirtz (3) or the Saissi (1) compass successfully employed during the latter part of the World War by experts in extraction.

Any simple method of precision is an improvement over a haphazard approach to the foreign body. We have combined the so-called surface localization of Violet with a precise means of internal anatomical localization using a contrast medium of iodized or bromidized oil colored with one per cent oil soluble green dye.<sup>2</sup> The oil can be visualized in the tissues by roentgenograms and its exact relation to the foreign body determined. However, unless this oil is stained with a vivid dye contrasting with the red of the muscle or the yellow of fat, it cannot be located in the tissues during the operation. Therefore, a brilliant green fat soluble dye is added to the oil. The absence of inflammatory reactions has been demonstrated by experimental injections of this preparation in human subjects during operations and into the muscles of dogs.

We first used methylene blue which is not oil soluble. Dissolved in sterile glucose syrup and shaken with iodidized olive oil into an emulsion. This preparation is also useful for injecting sinuses as it is radiopaque and when the sinus is to be dissected out is not found to permeate surrounding tissues as commonly occurs with an aqueous solution of methylene blue.

The method proposed can be employed in any hospital provided with an x-ray equipment and an operating room. Suitable wire screens can be made in a hardware store. These (Fig. 1) were devised by Dr. Mitchell S. Clift of Chicago.

and are of various sizes. The largest 9 by 18 inches with a 4 inch mesh is employed on the shoulder, buttock, neck or thigh; the smallest 1 by 1½ inches with a ½ inch mesh on the finger. These are bent to true right angles.

## TECHNIQUE OF LOCALIZATION

Preliminary films are first taken to be used as guides in determining the position of the patient on the operating table and the best position for the right angle screen to be applied. The patient is then placed on the operating table and securely fastened to prevent movement. If roentgenograms are to be taken in a separate room a wheel cart is employed from which he is not moved after the localizing roentgenograms are made. The operation is performed without moving him from the table or wheel cart or changing him to the position in which the localizing films were made.

If bodies are to be removed from the line from the dorsum of the neck or an extremity the patient must be immobilized and anesthetized in a prone position.

Next the skin is sterilized and the sterile right angle screen fastened to the part by a half hitch with tape or cord (Fig. 2).

A roentgen film is taken of each side of the wire screen with the tube centered and the normal ray at right angles to the flat surface of the screen. This can be checked with a carpenter's square. The distance of the tube should be a meter or more if this is practical. This distance insures a more nearly orthogonal projection of the film image.

From these films the surface localization can be accurately determined by counting off the interstices of the metal screen on the film image and on the skin. The body is outlined on the skin with a dye or metal points which are left in place until the operative incision is made.

The depth can be measured on the film of the other surface of the screen. Thus the surface localization can be determined on either film and the depth measured on the other.

A needle of appropriate length as measured on the metal screen is introduced through the surface projection of the foreign body in one plane of the screen and at right angles to it. Thus

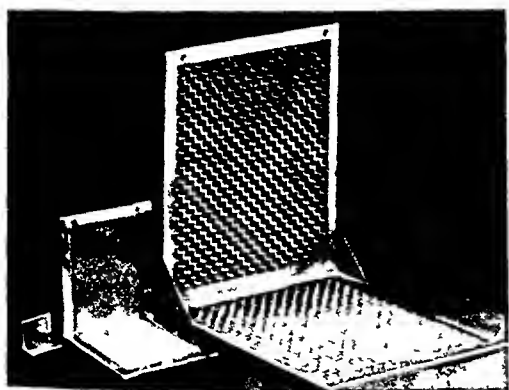


Fig. 1 Various sized screens for use in "surface localization"

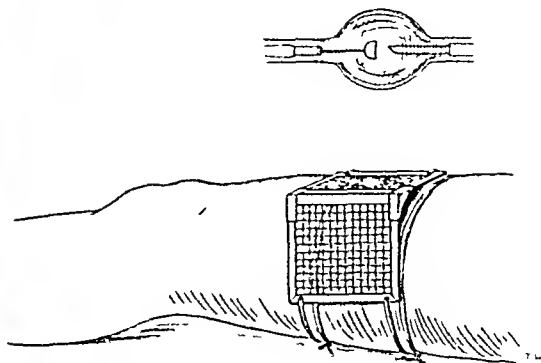


Fig. 2 Schematic drawing of position of screen and roentgen tube

the approach on the foreign body is easily made. This introduction is, of course, a matter of skill as well as precision. A few drops of the colored oil are introduced at the site where we expect the foreign body to be located. As the needle is withdrawn a fine trace of colored oil is left along the path by gentle pressure on the syringe. This may serve as a guide in the surgical approach to the deeply injected oil.

Another set of films is taken and the relation of the colored roentgen-ray opaque oil to the foreign body can be determined. If the first attempt is not successful and the deposition of oil is not in close proximity to the foreign body, the operation can be postponed for a few days, until the oil is dispersed, and another attempt to obtain internal localization by means of the oil can be made.

While several experts during the World War experience enthusiastically recommended needle localization or the use of skewers, placed in the part under fluoroscopic guidance, this requires much more experience than one who has not undertaken it would believe. Puncturing a part at random in a dark room is not without the danger that the needle may strike a nerve or large vessel. Furthermore, a needle inserted directly in the path of the "normal ray" appears only as a point under the fluoroscope. This difficulty, of course, may be obviated by using an angulated needle. It is much more laborious to reach the foreign body in a direction oblique to the ray and more perplexing to tell whether the point of the needle is nearer or farther away from the roentgen tube than the foreign body which is sought. If local anesthesia must be introduced each time before this attempt is made with alternate changing from dark to light during the application of

the anesthetic, the insertion of the needle is rather confusing to surgeons. For these reasons the right angle screen method with stained opaque oil has been devised.

However, if a foreign body can be localized with a hollow needle under the fluoroscope, the anatomical localization can be quickly established by introducing the colored oil and checking this thereafter with roentgenograms in two planes.

We prefer general to local anesthesia whenever possible, as local anesthesia often distorts the topography of the part.

#### OPERATIVE TECHNIQUE

The screen should be removed by cutting the tape holding it after the patient is anesthetized. Firm fixation of the part to be operated upon during the induction of anesthesia and complete muscular relaxation by anesthesia are both important considerations. Duval quotes the example of a bullet located in the adductors of the thigh which changed its position as much as 3 centimeters according as the muscles were contracted or relaxed and which was missed twice in operation.

A Martin bandage should either be applied before the roentgenograms are taken or else dispensed with entirely.

Before the skin incision is made and as each fascial plane is approached, points on either side of the contemplated incision line are seized with Allis forceps and lifted so that the pressure of the knife will not displace a movable body beneath. Wide exposure and a minimum of sponging is desirable. A single foreign body can be found in the colored oil. A collection of minute fragments or an encapsulated body can be removed by dissecting out the colored oil *en masse*.





## THE TRANSFER OF TUMOR CELLS BY THE SURGICAL KNIFE

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A NUMBER of surgeons discard the knife after it has been used for the removal of a biopsy of a malignant tumor and continue the radical operation with another knife or with a second set of instruments. This practice, however, is not universal and the same instruments still are used for both the removal of the biopsy specimen and for the radical operation. The former practice is primarily based on the fact that occasionally the tumor recurs along the operative scar at the site of the radical operation.

This communication is the result of the examination of the material which adheres to the blades of knives used for obtaining biopsies of tumors, particularly breast tumors. All the knives with which various types of malignant tumors were incised, were examined shortly after they had been used. Either direct smears were made from the respective blades or the blades were washed with

a small quantity of saline and smears were made from this suspension. The smears were stained with hematoxylin-eosin according to the method recently described by Martin and Ellis in their study of aspiration biopsies. Also, iron hematoxylin preparations of the smears were used satisfactorily.

Invariably, smears which were made from the material on the knives used to cut through the tumors showed tumor cells. In some instances, the tumor cells were so abundant that at low magnification their numbers were comparable to that of erythrocytes on a blood smear of average thickness. Also, smears which were made from material on the knives used for removal of the primary tumor for biopsy before the radical breast operation was performed, revealed tumor cells.

From this study, it seems that every biopsy carries with it the danger of transferring, and pos-

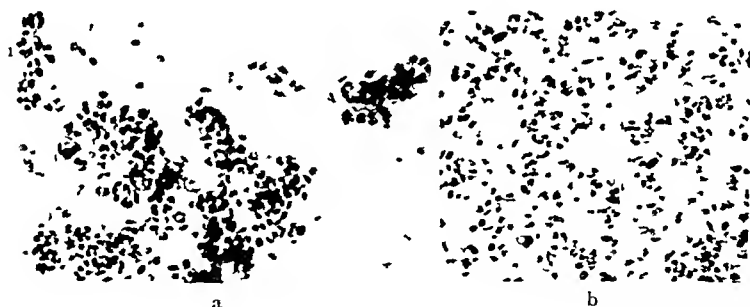


Fig 1 Smears made from blade of knife which was used for cutting through carcinoma of the breast (Iron hematoxylin eosin preparation a,  $\times 250$ , b,  $\times 200$ ). Note the clumps of carcinoma cells in a and the individual tumor cells in b.



Fig 2 Smears made from blade of knife which was used to excise carcinoma of the breast (a, Iron hematoxylin eosin preparation,  $\times 250$ , b, hematoxylin-eosin preparation,  $\times 250$ ).

sibly transplanting tumor cells into healthy tissue. By means of supravital dyes (Hickling) reasonable evidence was obtained that the tumor cells on the knives were still viable. One factor therefore essential for the propagation of tumor was present namely living tumor cells. Whether or not these tumor cells actually encountered suitable environment or fertile ground essential to their growth is the other factor which of course cannot be ascertained. The potential danger of transplanting tumor cells by the knife is proportional to the number of tumor cells attached to the knife. Hence the incision into the primary tumor carries a greater danger than the incision about the primary tumor.

The facts here presented may also explain the special danger pertaining to the incision of the tumors (Hellwig) but from a different point of view than the author implies. Whereas Hellwig speaks of stimulation of growth and dissemination of tumor cells through the blood and lymph vessels these dangerous sequelæ may be explained by the dropping of viable tumor cells which may actually be transferred into the blood vessels or tissues by the dissecting knife. The perilous effect of tumor cells adherent to the blade of the knife is clearly brought out by Bloodgood's statement gained by experience which stresses the danger in excising a cancer of the breast without the use of the cautery and then waiting longer than 2 weeks before the radical operation. Greenwood, Bland Sutton, Bambridge and others are of the opinion that one of the most vital principles of surgery in malignant disease is that cutting into cancerous tissue leads to a spread of the disease. It is apparent that this spreading of tumor cells by the knife may easily be the underlying factor which leads to the acceptance of this principle. These authors also gained this view by following up the individual patients rather than by the actual finding of tumor cells on the knife.

It is noteworthy that Rydall in 1908 stated: A scalpel which has been used for mere incision into a cancerous growth has as a result cancer cells almost invariably clinging to the blade and I think I can safely say that cancer cells are always liberated into the blood escaping from the

incision. The viability of these cells however was not proved. Butlin one year previously remarked that the instruments which were used for the purpose of diagnosing the malignant tumors must not be used again until they have been boiled. Ewing very recently recommended the change of gloves and instruments after the performance of a biopsy of malignant tumors.

In view of the findings here presented it is imperative to change the knives not only after removal of the biopsy but also after excision of a malignant tumor before a radical operation.

#### SUMMARY

Examination of the blades of knives used for removal of biopsies from malignant tumors or for removal of seemingly well circumscribed malignant tumors revealed a varying number of apparently viable tumor cells. These tumor cells represent a potential danger as they may be a source of local recurrence and also of metastasis. One important source of local recurrences of malignant tumors therefore may be avoided if the dissecting knife and other instruments are discarded after the removal of the biopsy of the primary tumor before proceeding with the radical operation.

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## AN ARTHROPLASTIC OPERATION FOR CONGENITAL DISLOCATION OF THE HIP—A TWO STAGE PROCEDURE

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THE treatment of congenital dislocation of the hip in the majority of the cases over 3 years of age is more satisfactorily accomplished by some form of open operation than by any method of closed reduction.

The method presented here is a two stage procedure and has been employed a number of times since it was first described in the *Journal of Bone and Joint Surgery*, January, 1932. Six case histories with pre-operative and postoperative roentgenograms are presented, the first of which was done in 1930 and the last over one year ago.

Briefly, the first stage consists of a thorough stretching of the muscles about the hip, subcutaneous tenotomy of the adductors, and skin or skeletal traction preliminary to open operation.

At the second stage the portion of the hour-glass, synovial membrane-lined capsule covering the head is preserved and placed deeply within a reamed out acetabulum. This arthroplastic type of operation has as its aim the actual reduction of the dislocation, the restoring of stability to the hip joint, and the preservation of a satisfactory range of mobility. To date the procedure has not been used in those cases in which it was felt closed reduction would suffice and in general one may say the best results have been obtained in children under 10 years of age.

**Anatomical considerations.** In the backward and upward displacement of the head of the femur that is usually found in congenital dislocation of the hip, a recognition of the relationship of the head of the femur to both the vertical and horizontal planes of the acetabulum is of essential importance. Therefore, unless the head is brought not only downward but forward, the awkward lurch in walking is not corrected.

With the primary maldevelopment of the acetabulum and upper extremity of the femur there are accompanying secondary changes in the soft tissues. As these patients begin to assume the stresses and strains of activity, the muscles and ligaments assume the brunt of the burden of weight bearing. The capsule becomes elongated to accommodate the upward and backward displacement of the head of the femur producing the so called "hour-glass" appearance and the capsular ligament over the neck and head of the femur becomes thickened. The interior of this

elongated capsule is in reality a portion of the hip joint and is lined with synovial cells. The lumen of the isthmus at the contracted portion may contain the attenuated ligament teres or one may be unable to identify the teres as a definite structure and the lumen appear obliterated by fibrous tissue. At operation an excess of synovial fluid in this capsular sac about the head often can be seen.

The pelvic-trochanteric group of muscles, as well as the adductors, are contracted and act as definite barriers to reduction. For this reason the first stage of the procedure advocated has been a very beneficial preliminary measure.

While the time of follow-up with the procedure advocated is insufficient to draw any definite conclusions as to what will be the ultimate functional and roentgenographic appearance of these hips, certain observations have been noted in the patients operated upon. The hips have all remained reduced and stable with a varying degree of movement. In general it may be stated that an excellent range of movement has been obtained up to the age of 8 and in a few cases above the age of 10. By cutting through the greater trochanter a stimulation of its growth has been observed and this in the later cases appears to have been lessened by carefully removing only a small portion of the cartilage when the abductor muscles are reflected upward during the second stage. A surgical fusion of this epiphysis at this stage might obviate this, but it has not been considered necessary to date. An increased density of the roof of the reamed out acetabulum has been a frequent finding and we must assume that the transplanted capsule about the head becomes attached to the newly formed acetabulum allowing the head to move easily within the reconstructed acetabulum. The depth of the reamed out acetabulum appeared either unchanged or in some instances even appeared to have become deepened after several years of weight bearing.

The roentgenographic development of the epiphyses has been uniform, i.e., those cases that presented either fragmentation or irregular outline of the epiphysis preceding open operation, have continued to show certain characteristics of Perthe's disease or occasionally improvement in the appearance of the contour of the epiphysis, while those with smooth outlines and

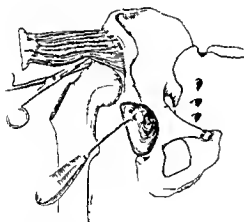
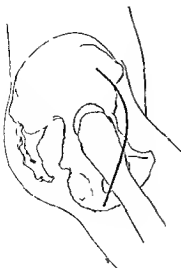


Fig. 3. Drawing of the hip joint, showing the femur, acetabulum, and surrounding soft tissue structures. Fig. 4. Drawing of the hip joint, showing the femur, acetabulum, and surrounding soft tissue structures. The following text is a transcription of the handwritten notes below the figures:

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normal structures before operation have continued their apparently normal growth

#### OPERATIVE PROCEDURE

*First stage* Ten to four hours before any preliminary stretching is done moleskin adhesive

straps are applied to the affected limb extending up to within a few inches of the tip of the greater trochanter. The following day after the mole skin has well attached itself to the skin the dislocated hip is thoroughly stretched under anesthesia and the adductor muscles subcutaneously

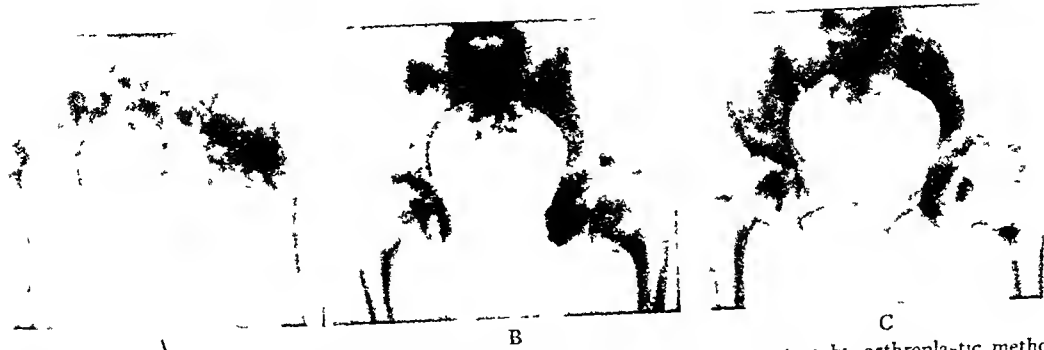


Fig 2 Case 1, P S, age 7 years. A, Bilateral congenital dislocated hips. B, Appearance of right hip 1 year after open operation. Hip pried into place by means of skid and without interposition of capsule. Appearance of left hip

6 months after open operation by arthroplastic method described. C Five years later. Left hip has remained freely movable and the right hip has become practically stiff.

tenotomized. A long plaster spica is applied to the opposite side and 10 to 15 pounds of skin traction is immediately applied to the side being treated. This weight is increased gradually over a period of 2 or 3 weeks. In some cases, skeletal traction has been used. Roentgenograms are taken with and without traction to determine the actual stretching of the soft tissues obtained, and when the head is opposite the original acetabulum open operation should be done. When the maximum stretching has been obtained the plaster spica is bivalved and the hip region prepared in the usual manner, disturbing only as little as necessary the moleskin straps. The patient is sent to the operating room with the traction intact.

**Second stage** In some instances the Smith-Peterson approach has been employed, though the following procedure has been found more satisfactory. A skin incision is made beginning about 2 inches behind the anterior superior spine, curving forward, downward, and then backward, as shown in the diagram, to a point about 2 inches below the tip of the greater trochanter. The rectus femoris tendon at its origin from the anterior inferior spine is identified and in some cases has been divided by zigzag tenotomy. The fascia on the lateral aspect of the thigh is divided transversely, and a portion of the greater trochanter with its attached gluteal muscles is identified, chiseled through, and turned upward. The elongated portion of the capsule of the hip joint covering the head of the femur is easily identified and separated from the surrounding structures anteriorly and posteriorly by scissor dissection (Fig 1). When the isthmus of the capsule is reached, it is divided and the head of the bone is inspected, its shape and the presence or absence of the ligamentum teres being noted. The opening in the capsule over the head is then

closed with several chromic sutures. With Doyen reamers or a large curette, a capacious acetabulum is formed, as near its original site as preliminary traction has made possible. The site of the acetabulum is further checked by identifying the tri-radiate cartilage in the floor of the acetabulum. Then the capsule covered head is pulled down and without tension placed in the deepened and reamed-out acetabulum, the abductor muscles with the attached cartilage from the greater trochanter are sutured back into place, and the wound is closed in layers. In some instances weights were re-applied, at the operating table, to the traction straps and a plaster spica, extending from the ankle to the axilla with the limb in about 20 degrees abduction, was applied to the operated limb. This traction usually remained in place for the following 2 weeks, and then the ends of the straps were cut off and plaster was applied to the foot. In the younger patients postoperative traction did not seem necessary and a long plaster spica was applied in the operating room.

The plaster is retained for 4 weeks and, after removal, active and passive movement of the limb in bed is encouraged. No weight bearing is advised for at least 3 months after open operation.

**CASE 1** P S (Figs 2, A, B, and C) A boy 7 years of age was admitted to the Orthopedic Service at Bellevue Hospital in June, 1929. He presented the characteristic features of bilateral congenital dislocation of both hips.

December 15, 1929. The right hip was operated upon without preliminary traction and reduced with difficulty. The head was forced into a reamed out acetabulum with a skid. The result proved unsatisfactory and the hip has become increasingly stiff. As shown in the roentgenogram, the bony proliferation about the joint has continued to increase since operation.

June 1930. The procedure here advocated was performed on the left hip. The left hip structures were stretched and the adductors tenotomized and heavy skin traction was applied, as described in the first stage of the operation. Several weeks later, i.e., June 16, 1930, the



Fig 3 C e s P Z g 14 years of age prese ting right congenital d loc t of th hip A Roentgenogram t ken at the end f the first stage sh ing the bad w l p lled d n oppo te the t b l n B 3 1/2 ve s po tope t R ng of m v me t f r e n all d r e c t i o n s N t d n t y o f a t a b u l a r m d p e r v e r s i o n f j o i n t p c e



Fig 4 C e 3 A 1 g r 6 y e a s o f e c o n g e n i t a l d i s c t f r i g h t i p B r o e t g e o g r m a t d f i r s t s t a g e C 2 3 a s a d n n t h s a f t e r p t R n g f m m a t f e n l l d e c t i o n s N t d e n s i t y f e l l u l r u m a n d c i b l a r j o i n t p a e



Fig 5 C e 4 D K g 14 1/2 y e a s o f a g e p e s e t i n c n g n i t a l d l o c a t o f l f t h i p B T w y e a s d i m t h f i c p e i u P n t x c l i n t r a n g e o f m e t n l d e c t o d n o s h o t r n g T h e v d g s h a p e d p p e r a n c f t h i p h y s i s h a s p e r s i d b t t h e o t h e p p e a n o t h a d t h d e v e l o p m e n t

second stage s c m p l t e d R t g o g r a m t l n a n d 5 y e a r s a f t e r p t u o n h n n d t h i s j n t d a y p e s e t s b u t 8 o d g e i n t a r y f u s i o n c o m p l t e x t e n n T h p p s t o h e e d e l p e d d i n t j o t p e

This was the fir t case in which the procedure was employed and permits a comparison o c r a 5 year period of two different methods of treatment

CASE 2 P Z (F i s 3 A d B) A g a l o f 4 y e a s a d m i t t e d t o t h i l l f a l f t h R j u e d n d C p l d i n N e m b e 9 1 p e s e t g c o g a t l d i l o c a t i f t h r i g h t i p T h p a t n t h d b d a y p t u t r i n e n t f t h d i l o c a t n d p s e t d t h a t r s t f i d n g s f a u n t a l d i s t t T h w a s h a l f i n h b o t n i n g a n d p s i u v T d i l b u g

Not m b 2 932 first stage  
De m b 5 932 th seco d tag  
At p e t h c h i l d w l k s w t h u t l p T h i n o  
h t g a d h b a s a n r m l n g f m m e t A t  
t t l e d t o t h w i d t h f i n t p c a n d t h e u  
d a p p a n t s m o t h n f t h n f t h e p p h y s i s i f  
3 a r s f t e p t n  
C A E 3 A 1 (F i g s 4 A B a d C) A g f 6 a d  
m i t t e d t t h e O t h p e d S e r v o f B l l H o s p t l n  
A p l 933 p s e n t i n g a g e t a l d l o c t f t h g h t  
h i p W h a t h e h d w f t s e l a t t e m p t s h a d  
b e e n a d e t d e t h d l o c a t o b u t h d b e n  
u c f l f h h u l d w g o o d g u r l c d i d  
p s e n t d t h h t t u g a i t f r o b t d e d d l o c k  
t n T e d f n b u r g t w s p o t e a d t h e  
s i t e i n g f i t h r q u t r s f i h  
A p r i l 6 1933 t h f i r s t s t a g



Fig 6 Case 5, D R, girl of 3 years presenting congenital dislocation of the right hip with some instability of the left B, 13 months after operation Shows secure right hip with excellent range of movement in all directions I left hip not treated

May 5, 1933, the second stage

At present the child walks without a perceptible limp. There is no shortening, and she presents an almost normal range of movement in all directions. Roentgenograms 2 years after operation show a well formed joint space, and the epiphysis is smooth in outline and appears to be developing normally.

CASE 4 D K (Figs 5, A and B) A girl of 4½ was admitted to the Hospital for the Ruptured and Crippled in December, 1933, presenting a congenital dislocation of the left hip. This child had previously had three attempts at closed reduction and each time the dislocation had recurred on removal of the plaster. The child was in good general condition and presented a marked limp on walking. There was half an inch shortening.

January 3, 1934, the first stage

January 15, 1934, the second stage

At present the child walks without a perceptible limp. There is no shortening and she presents a normal range of movement. Roentgenograms before operation and 2 years after operation are shown.

CASE 5 D R (Figs 6, A, and B) A girl of 3 was seen at the Hospital for the Ruptured and Crippled in January, 1935. This patient had been under treatment at this hospital for the previous 6 months where the right congenital dislocation was reduced by closed manipulation but had redischarged. The child presented a rather insecure left hip and a frankly dislocated right hip. There was the characteristic limp on the right on walking and a shortening of ½ an inch.

No preliminary traction was necessary in this case.

February 13, 1935. Second stage on right hip

At present the child presents no shortening and no Trendelenburg on either side. She is very active and has a good range of movement of the right hip in all directions. Roentgenograms before operation and 1 year after operation are shown.

CASE 6 B A (Figs 7, A and B) A girl of 3 years and 10 months was admitted to the Hospital for the Ruptured and Crippled in October, 1935. This child had previously had two unsuccessful attempts at closed reduction. She presented a right congenital dislocation with a shallow acetabulum with a deficient roof, so that further attempts at closed reduction were not considered. She was in good general condition and presented the characteristic limp on walking.

October 1, 1935, the first stage

October 25, 1935, the second stage

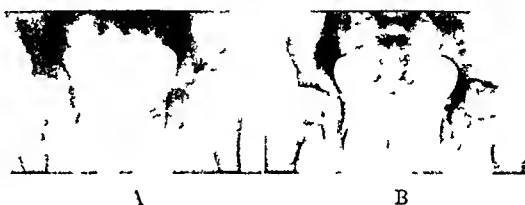


Fig 7 Case 6, B A, girl of 3 years and 10 months presenting a right congenital dislocation B, One year after operation Has an increasing range of movement in all directions and walks without a limp

At present the child is walking with a barely perceptible limp. She shows no shortening and has a range of movement from 180 to 80 degrees with a slight limitation of movement in all other directions. Roentgenograms before and 1 year after operation are shown.

#### SUMMARY

1 A two stage operative procedure for congenital dislocation of the hip is presented. It represents an attempt to devise a procedure in which not only actual reduction and stability can be promised but by preserving the synovial and capsular covering about the head, an opportunity is afforded for obtaining a free range of movement.

2 The preliminary lengthening of the contracted tissues by the first stage described is felt to be a very essential step.

3 If the capsule covered head does not slip easily into the reamed out acetabulum and requires any forcible reduction, pressure necrosis of the synovial cells may occur, limiting the opportunity for future motion.

4 It is felt that this procedure is best suited to patients under the age of 10 years.

5 Sufficient time has not elapsed for an end-result study to be made of this procedure, but the method is presented in the hope that it may be tried by others and properly evaluated.

## FRACTURES OF THE OS CALCEI

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 Sect. Orthopedic S. g. 13 Th. M. y. Cl. u.

THE longitudinal arch of the foot has for its posterior base the os calcis and for its anterior base the heads of the metatarsal bones. On the inner side the highest point of the arch is at the junction of the astragalus and scaphoid and on the outer side it is at the calcaneocuboid juncture. The latter point is at a considerably lower level than the former and this arrangement forms a semidome. The foot will tolerate a gradual lowering of this arch fairly well but any sudden lowering as a result of trauma is always attended with distressing symptoms. Fracture of the os calcis may lead to such an abrupt lowering of the arch and to such an alteration in the semidome shape that great disability will ensue.

STATISTICS BASED ON FIFTY-FOUR CASES AT  
 THE CLINIC

In a consideration of any fracture it is usual to present a classification embracing the various types of fractures encountered in the bone under discussion. This I am not going to do because it has been well done in the textbooks on fractures and such a presentation would consume so much time that it would be impossible to consider the clinical phases of this troublesome fracture. I will not attempt to give any estimate of the average length of disability for after a careful review of the clinical records of 54 consecutive cases of fracture of the os calcis in the files of The Mayo Clinic I was so much at sea that I realized the futility of such an attempt. So many factors enter into such an estimation that such a study is of no practical value.

The study of the records, although disappointing from the viewpoint mentioned, nevertheless furnished some information of interest. In the 22 cases in which there were fresh fractures 20 of the patients were males and 2 were females. In 3 of these cases there were double fractures. Seventeen of the fractures were the result of falls, 2 of the fractures which were double were the result of explosions from below which had forced the floor upward, 1 was the result of an automobile accident and in 2 instances the type of injury was not recorded. Three of the fractures were compound. In 6 cases the results were not known. In 7 cases the results were excellent and the patients returned to full duty usually in 3 to 4

months with little pain. In 6 cases in which the results were classified as good the patients were able to carry on but with some pain and discomfort. In 2 cases the results were only fair but at the end of a year the patients were able to get about and carry on their activities. One of these patients was a farmer and the other was a housewife. One patient, a railroad employee who was 67 years of age, claimed that he was completely disabled 2 years after the accident.

These results are much better than one would be led to expect according to the literature. Why is this? It is not because of any specific type of treatment for the majority of these patients were treated with plaster of paris casts which were applied after a molding of the fragments was done in an effort at reduction. The reason is that the length of time is not taken into consideration and comparatively few were industrial compensation cases. As long as 6 years have elapsed in some cases since the accident and although the result would have been classed as fair or perhaps poor when the patients first resumed work, gradual improvement has taken place. In the tabulation of the result, no consideration is given to the anatomical restoration; only function is considered. The return to duty was delayed in those cases in which the patients received compensation insurance and improvement took place more slowly in those cases in which no job was awaiting the patients than it did in cases in which a job was available. The occupations of the patients varied: 1 were farmers, 2 were painters, 1 was a plasterer, 3 were carpenters and 5 were laborers. Eleven of the 22 were more than 50 years of age.

To evaluate figures of this kind properly many factors would have to be considered such as the type of fracture, associated injuries and so forth. To deal further with statistics is useless but I would like to mention briefly the 32 patients who came to the clinic because of old fractures of the os calcis. In these cases the length of time which had elapsed between the occurrence of the fracture and the arrival of the patient at the clinic varied from 12 weeks to 26 years. None of these patients had been treated at the clinic primarily. Five were more than 50, 14 were between 40 and 50, 9 were between 30 and 40 and 4 were between 20 and 30 years of age. There were no women in this group.



The cause of the disability in 21 cases was definitely recorded as astragalocalcaneal traumatic arthritis. Arthrodesis was advised in 14 cases, but only 3 patients were operated on. The reasons that so few accepted the advice are several. First, the disability was of long duration and the patients could get about. Second, there was the dread of the complete disability, which would last for 3 months and perhaps longer if arthrodesis were done, and the consequent loss of earning power and expenses incidental to the procedure. Third, most of the patients felt that they were slowly improving and that, by aid of the proper shoes and reasonable care in walking, they would be able to reduce their discomfort.

#### LENGTH OF DISABILITY

It may be assumed safely that compensation insurance has definitely prolonged the disability which follows fractures of the os calcis, and, therefore, this fracture perhaps has received a blacker name than it deserves. When the individual can receive as much for doing nothing as he can for doing what he is able to do, there is no incentive for him to return to work, for he can only do part time work when he first returns, and his earnings under those conditions will be small. This situation prompted Conn, of Akron, to advance his admittedly complicated program to shorten the disability. He advised immediate manipulation and skeletal traction, to be followed 5 weeks later by astragalocalcaneal, astragaloscaphoid, and calcaneocuboid fusion. In cases of old fractures, he advised the triple fusion alone.

#### PATHOLOGY AND TREATMENT

The pathological changes in fractures of the os calcis vary with the force and its line of transmission. Boehler has studied the type of fractures encountered in a large series of cases and has tabulated eight types. I will make no attempt to discuss these. The fractures which cause the greatest trouble are those of the "crunching" type, in which there are varying degrees of damage to the articular surfaces and to the sustentaculum tali. The latter is fractured much more often than is generally supposed although isolated fractures of this process are rare. It often has been said that if the astragalocalcaneal joint is not broken into there will be no subsequent arthritis in that joint. Such a statement is not correct. The fracture through the body, which often is associated with upward displacement of the posterior portion, leads to such changes in the form of the os calcis that the weight-bearing lines are more or less altered, and the normal articular surfaces of

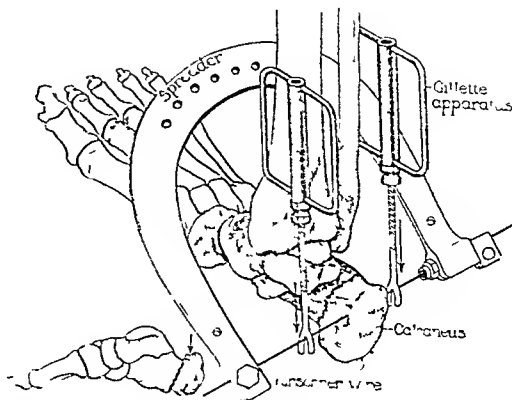


Fig. 1 Insertion of Kirschner wire and use of the Kirschner stirrup and push rods

the astragalus and the calcaneus bear the weight through greatly altered planes. Boehler's interesting observations on the salient angles have demonstrated this fact. Definite traumatic arthritis ensues, with thinning of the articular cartilage and formation of adhesions.

The aim in reduction should be restoration of the fragments of the fractured bone to their normal relationship. This is not easily secured in most cases, for a fracture of the os calcis is often produced by great force and there is comminution with a certain amount of irreparable crunching of the lamellæ of the substantia spongiosa. The fracture may be almost stellate and fragments may be multiple. All that can be done then is the molding which has been advocated and carried out so skillfully by Boehler. In other more fortunate instances, the posterior tubercle may be merely pushed upward, and there may be little crunching of the substantia spongiosa. It not only is difficult to reduce it, but also to make it stay in position. Various methods have been advocated and one, which was advised by Gillette, I have used with some degree of success in several instances. I think the Kirschner wire could be used to advantage over the rather heavy peg or nail advocated by Gillette.<sup>1</sup> By incorporating a pair of crutch-like pushers that fit over the wire or peg, and by inserting the threaded arm of the crutch, on which is a set-screw, into metal canals incorporated in the cast, pressure can be made downward on the wire, and thus on the displaced fragment (Fig. 1). The wire or peg must be accurately placed in the displaced fragment to insure its reduction. If placed too far forward, it

<sup>1</sup>A personal communication from E. P. Gillette, Toledo, Ohio, states that he has modified his original technique by putting a pin through the tibia, incorporating it in a cast. He is thus able to leave the knee free.

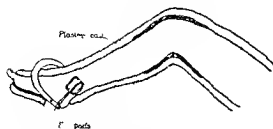


Fig. 2. Leg in cast with knee flexed and Kirschner wire through calcaneus.

does little good for it leaves the tubercle tilted upward by the tendo achillis. By flexing the knee to a right angle, thus relaxing the tendo achillis and padding well the popliteal space and the knee particularly anteriorly, great force can be put on the fragment by this arrangement (Fig. 2).

Conn, by aid of an ingenious instrument inserted slotted metal strips on each side into the transfixing pins in the tibia and os calcis and incorporate them in plaster.

These procedures are on the whole too complicated for the surgeon with no special equipment and are rarely used. The majority of fractures of the os calcis will continue to be treated in the old way by manipulation and casts. By such means very little reduction of the fragments actually is accomplished. Late poor results therefore will demand interference but the majority of patients after varying periods of disability will attain such a degree of functional improvement that they may resume their duties although they may be handicapped to a degree.

#### RECONSTRUCTION IN OLD FRACTURES

There are three relatively common sequelae that can be remedied to a certain extent by operation. First, in fractures in which the posterior portion of the os calcis is shoved upward and allowed to unite in that position a prominent tubercle or exostosis may form on the inferior surface. Chiselling this away and smoothing down the surface does help. The arch may be very definitely flattened but the foot will gradually accommodate itself.

Second, beneath the external malleolus where the external supporting wall of the bone gives way along the region of the peroneal groove a callus may form that almost impinges on the mal-

leolus when the patient walks. Chiselling this away will relieve the patient of much of the pain.

Third, the distortion of the os calcis and altered weight bearing lines may distort the articulation of the astragalus and scaphoid and that of the os calcis and the cuboid sufficiently to produce very definite traumatic arthritis in these joints so that even though the chief fault lies in the astragalocalcaneal joint fusion of this joint alone will not relieve the patient. In addition the two other joints mentioned should be fused and the typical triple arthrodesis which has been found so useful in the treatment of flail feet following infantile paralysis should be carried out. Although lateral mobility which is permitted by the astragalocalcaneal joint will be destroyed these patients already have but little of it left and what is left is only a cause of discomfort. Furthermore the varying degrees of compensatory movement of the forefoot soon develop and help to compensate for the rigidity of the posterior portion of the arch.

#### CONCLUSIONS

1. Fractures of the os calcis leave in their wake considerable disability that over a term of years gradually lessens until most patients are able to resume their occupations.

2. The length of time that the discomfort persists and the inability of the patient to carry on full duty place these fractures as a particularly bad group for compensation insurance and explain the wherefore of the advancement of such an admittedly complicated program as that of Conn.

3. The majority of fractures of the os calcis will be treated by less complicated procedures. In cases in which disability persists as a result of exostosis or traumatic arthritis the patients can be treated advantageously by removal of the exostosis and by triple arthrodesis of the astragalocalcaneal, astragaloscaphoid and calcaneocuboid joints.

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THE BLADDER COMPLICATIONS OF CARCINOMA OF THE CERVIX<sup>1</sup>ROGER C GRAVES, M D, F A C S, C J E KICKHAM, M D, AND IRA T NATHANSON, M D,<sup>2</sup>  
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From the Urological and Gynecological Clinics of the Pondville Hospital (Massachusetts Department of Public Health)

A GENEROUS experience with the urological complications of carcinoma of the cervix and an opportunity to study the records of 683 cases of this condition, have led to the conviction that too little attention has been directed to the fact that the spread of this disease commonly affects the organs of the urinary system. In another communication about to be published, we have discussed the high incidence of ureteral occlusion and have shown, in a large series, that significant obstruction of the ureters occurred in 78 per cent of those patients in whom there had been malignant invasion in the regions of the broad ligaments. In this paper, it is our purpose to consider separately the changes which take place in the urinary bladder in cervix carcinoma as a direct result of the disease, or during the course of its treatment.

Our material is drawn from the 683 cases of cancer of the cervix that have been admitted to the Pondville Hospital (Massachusetts Department of Public Health), since its establishment in June, 1927, and until January, 1936. These have been reviewed through the courtesy of Dr J V Meigs, chief of our department of gynecology. From this group we have selected 209 cases in which the clinical evidence pertaining to the bladder was sufficiently complete to serve as a basis for this discussion.

The ages of these patients were as follows: 21 to 29 years, 5 cases, 30 to 39 years, 37 cases, 40 to 49 years, 68 cases, 50 to 59 years, 48 cases, 60 to 69 years, 34 cases, 70 to 79 years, 17 cases. The American College of Surgeons classification was used in denoting the extent of disease. There were in Class A, 10 cases, Class B, 18 cases, Class C, 67 cases, and in Class D, 114 cases. Grouping as regards degree of malignancy of the cervix tumor was based upon three grades, of which Grade 1 represents the adult, well differentiated epidermoid carcinoma, and Grade 3, the highly malignant, undifferentiated type. The report was Grade 1, in 22 cases, Grade 2, in 53 cases, and Grade 3, in 60 cases. There were 59 reports of epidermoid carcinoma, ungraded, in practically all of these, previous radiation therapy before admission at Pondville precluded the possibility of more accurate histological description. Thirteen cases were classified as adenocarcinoma, and in 2

instances the exact type of tumor was unknown. As regards the character of growth, three general types are recognized, proliferative, ulcerative, and invertive. The proliferative group includes those cases in which growth is chiefly outward from the cervix. These tumors are described commonly as fungating, outcropping or cauliflower-like in form. Vaginal extension, mucosal or submucosal, may occur in this group. The ulcerative type leads to the destruction of the cervix, but may extend also along the walls of the vagina. The invertive or infiltrative tumors are predominantly endocervical. All three types, of course, may extend upward and laterally into the broad ligaments, posteriorly toward the rectum, or anteriorly toward the bladder.

Seventy-four of the series are living, and 135 have died. There were 93 autopsies. One hundred and six of the 209 patients under consideration received their first treatment for malignant disease of the cervix at the Pondville Hospital. Twelve were untreated cases, and the remainder had had treatment in other institutions before entering Pondville. Practically all of the latter group were given further therapy with roentgen-ray or radium after admission.

Natural variation in the thoroughness of history-taking, and the common occurrence of bladder disturbances in women not afflicted with cancer, make it futile in this discussion to attempt an analysis of clinical symptoms, or to derive fixed conclusions from such complaints when present. In some instances there appear to be no significant symptoms, many report an increased frequency of urination, and it is our impression that this is the most common of the symptoms referable to the bladder. Painful micturition, which may result from the advent of infection or extravescical pressure, or actual malignant invasion of the bladder, was reported by some of the group. As regards hematuria, the clinical history is often inaccurate and unreliable, in carcinoma of the cervix. Four of the 12 cases in our series who had radium ulcerations of the bladder proved by cystoscopy, gave a record of the sudden appearance of blood stained urine. Hematuria in some degree, either gross or microscopic, must occur much more frequently than the records would indicate in all those cases in which there

<sup>1</sup>Read before the Philadelphia Urological Society of the American Urological Association, Philadelphia, Pennsylvania, March 23, 1936.<sup>2</sup>Lucius N. Littauer Fellow in Cancer, Harvard University Medical School.

TABLE I—NEGATIVE CYSTOSCOPIES

	Class				Grade				Type of disease			
	A	B	C	D		S	AC	E	P	U	I	?
Before treatment (10 cases)			6			4			3	3		
After treatment (5 cases)							3					
Total—5	3	3	6			3	3		3	3		

P—Proliferative.

U—Ulcerative.

I—Infiltrative or in situ.

?—Likely to metastasize.

AC—Adenocarcinoma.

E—Epithelioma of the bladder, not defined.

TABLE II—CYSTOSCOPIC FINDINGS

		Class				Grade				Type of disease			
		A	B	C	D		S	AC	E	P	U	I	?
Primary cases Before treatment (10 cases)	EVP			6			4			3			
	TE			3									
	EVP & TE			4	1		3			1	1		
Distorted cases (5 cases)	EVP			4			3			3			
	TE												
	EVP & TE			3			3	3	3	3	3		
Secondary cases After treatment (5 cases)	EVP												
	TE				3				3				3
	EVP & TE												
Total—5		3	3	6	1		3	3	3	3	3		3

TE—Tuberculous.

EVP—Extravesical pressure.

has been mucosal involvement by radium reaction or by tumor.

The story of incontinence is equally difficult to evaluate. Next to increased frequency, we found it the most common symptom. Except perhaps in cases of large vesicovaginal fistulas, it is partial rather than complete. Obviously the presence of a profuse discharge from the vagina may lead to uncertainty on the part of the patient as to the actual existence of urinary leakage. It is our opinion that loss of control when present results chiefly from extravasical pressure and distortion in the region of the bladder neck, or from a vaginal fistula, more often than from any of the other causes which might be predicated in this condition, such as malignant invasion of the vaginal outlet, or the effect of massive irradiation.

Partial retention with residual urine may occur in some of these cases, but we have no definite information concerning it. Complete retention due to urethral obstruction by tumor has been encountered in a few instances in this series.

There were in this series 105 patients who were examined by cystoscopy on one or more occasions. Forty three were so studied prior to direct cervix

therapy which in this as in the whole group consisted usually of radium application or high voltage roentgen ray or both. Sixty two were examined for the first time during or after treatment. In 16 of 105 cases there were no noteworthy changes to be seen within the bladder. In 10 of these the cystoscopic examination was made before cervix therapy was begun. For further data concerning this negative group, see Table I.

Many patients showed at cystoscopy the earliest sign of direct bladder disturbance by the malignant process in the form of distortion from extra vesical pressure (Table II). This consists usually of a uniform elevation of the proximal trigone and posterior wall, covered with normal mucosa and unaffected by distention. It may resemble the ordinary uterine prominence seen so often in the female bladder floor, or may be so accentuated as to form deep lateral sulci on each side. Obviously the distortion must be interpreted with care and must be correlated always with the findings on pelvic examination. It may be produced by the tumor, or by the reaction following radiation by an inflammatory process in or around the uterus, or merely by an anterior lying fundus.

TABLE III—TUMOR BY CYSTOSCOPY

	Class				Grade					Type of disease			
	A	B	C	D	1	2	3	AC	E	P	U	I	?
Before treatment Primary cases—7	0	2	1	4	0	1	4	0	2	3	3	1	0
During treatment Primary cases—3	0	0	3	3	0	0	7	0	1	5	1	2	0
After treatment Secondary cases—3	0	0	2	6	0	2	1	0	5	0	5	0	3
Total—23	0	2	8	13	0	3	12	0	8	8	9	3	3

Extravesical pressure has been referred to by many writers. Marzetti calls it *bombement* and states that it is the most common abnormality found by cystoscopy in carcinoma of the cervix. It is of interest that Korkhov found by cystoscopic inspection, definite improvement in the bladder outline in 50 of 100 cases following radiation therapy. Aman-Jean reported similar observations and believed that cystoscopy might serve as a guide to the efficacy of treatment, by revealing the presence or absence of such change. We are quite in accord with these conclusions.

As malignant disease advances toward the bladder, or comes actually to invade it, one sees localized areas of congestion and submucous hemorrhage followed still later by edema. Edema, usually associated with distortion by extravesical pressure, was observed frequently (Table II). It probably signifies in most instances the presence of carcinoma in the bladder wall beneath the edematous area as Schmitz, Vermooten, and others have agreed. However, one might suggest the occasional possibility that inflammatory reaction around the tumor in a region adjacent to the bladder might produce a similar picture. The edema resulting from radium reaction will be discussed in a later section.

Further invasion of the bladder by tumor may lead to submucous nodules or definite neoplasm projecting into the vesical cavity, with or without ulceration (Table III). Actual tumor was apparent at the time of cystoscopy in 23 cases of this series, 15 of them presented such evidence before or during cervix treatment. In the remainder these changes were observed some time after the completion of active therapy. Herger and Schreiner, in a clinical study of 50 cases of advanced carcinoma of the cervix, found 14 instances of ulceration and infiltration of the vesical mucosa. Faerber reported bladder involvement in 58.7 per cent of 150 postmortem examinations.

It is of interest in this regard, that cystoscopy may lead to more accurate classification of the

case than is possible without bladder inspection. For example, 10 of our 23 cases with definite intravesical involvement had been classified as B or C cases on pelvic examination, but the proof of extension into the bladder places them at once in the D group. Furthermore, this would indicate that extension from malignant disease of the cervix sometimes may involve the urinary bladder before palpable invasion of the broad ligaments has occurred.

The end-stage of this whole process of malignant invasion, as far as the bladder is concerned, lies in the formation of a vesicovaginal fistula. Indeed, it is possible that most patients with actively progressive disease will develop this condition unless death occurs sooner from some other complication, such as hemorrhage, or uremia due to ureteral occlusion. We have found definite records of vesicovaginal fistulas in 62 of 683 cases of carcinoma of the cervix at the Pondville Hospital (Table IV). Of this large series, 226 are living, and 199 died at Pondville. We have, therefore, dependable information concerning 425 patients. In this number there were 55 known fistulas (12.9 per cent). The incidence among those who died in the hospital was 24.4 per cent, we know of 7 cases among those 258 who died.

TABLE IV—VESICOVAGINAL FISTULAS—  
62 CASES

Class	No.
A	2
B	3
C	11
D	46
Grade	
1	3
2	19
3	16
AC	0
E	24
Type of Disease	
P	12
U	37
I	3
?	10

# SURGERY GYNECOLOGY AND OBSTETRICS

## TABLE VA—NECROPSY FINDINGS

	Class				Grade				Type of disease				Total
	A	B	C	D	1	2	3	4	P	U	I	T	
Neg (8 cases)			3	1	5		3	3		4	6		17
W. l. a. (cases)			4	8			4						12
Mucosal vs (cases)			7		5	7	3	3	9	5	7		31.5
V. l. fistula (3 cases)				5	3	3	8		7	5	7		
T. l. a. o		4	8	7	3	4	7			6	10	3	5

outside the hospital but if all the facts were available in this group the incidence probably would be comparable. In the list of 26 living patients there are 7 with fistulas. Many of these living patients are cured but the incidence of fistula will increase of course among those who still have progressive disease. When active disease is present it is our feeling that the development of fistula may be accepted as a bad prognostic sign since the average length of life in our fistula group was but 0.4 years (about 5 months) after the appearance of this complication.

In its earliest stages the vesicovaginal fistula may be so small that its clinical or even its cystoscopic recognition will be difficult. This accounts doubtless for the fact that the highest incidence 33.3 per cent was found in our postmortem group of 93 cases. At autopsy minute communication between the bladder and vagina may be detected large enough only for the passage of a probe. It is true also that fistulas occurred more frequently among those patients who had further therapy at Pondville after having had treatment in other institutions before admission. It is possible that such secondary cases may have as a rule more advanced malignant disease it is probable also that the effects of re-treatment play an important part. We had 20 cases of fistulas in our primary therapy group (4.7 per cent) while there were 42 fistulas (45.2 per cent) in the group which had had treatment elsewhere before coming to Pondville. Not all of the latter group were re-treated in our clinic but

re-treatments especially with radium were more frequent in these secondary cases than in those in which the initial therapy had been given at Pondville. There were 7 patients who developed vesicovaginal fistulas before treatment of any kind had been given it is interesting that one of these now shows no evidence of active disease 2 1/2 years after treatment but the fistula remains. Of the whole series of 62 cases with fistula 7 showed complete regression of malignant disease 3 of these have died and while the postmortem examinations showed ureteral occlusion carcinoma was not found.

As has been stated there were 93 cases studied at autopsy (Tables VA and VB). It will be noted that 69.9 per cent presented bladder involvement varying in degree from invasion of the wall vesicovaginal fistula. Behney has reported an impressive series of 166 postmortem examinations in cases of advanced carcinoma of the cervix in which he found an incidence of fistula between the bladder and vagina of 22.3 per cent. In 86 of his series there had been no treatment and 25.6 per cent of this group had fistulas. The incidence in the treated cases was 18.7 per cent. He did not comment upon the lesser degrees of bladder involvement. Warren in another autopsy study reviewed 102 cases of malignant disease of the cervix and found that there were fistulas in 36 patients (35.3 per cent). He did not find a significant difference in incidence between the treated and untreated groups. Williams reported fistulas in 38 per cent of the untreated cases in a large postmortem series. Faerber found fistulas in 45.3 per cent of his cases.

The facts presented in Table VB are informing concerning the pathway of extension from carcinoma of the cervix and demonstrate that the local spread of disease may be anterior toward the bladder before marked parametrial involvement has occurred. We have seen patients clinically classified as B cases without broad ligament

## TABLE VB—NECROPSY FINDINGS

Neg. u.  
Bladder alone  
Ureters alone  
Ureters and bladder  
T. l. a. o

Showing frequency of bladder and ureteral involvement.

Cases  
3  
3  
6  
5  
93

TABLE VI—RADIATION REACTION

	Class				Grade					Type of disease			
	A	B	C	D	1	2	3	AC	E	P	U	I	O
Primary (8 cases)	4	2	2	0	2	2	2	0	2	3	1	4	0
Secondary (4 cases)	0	1	3	0	0	0	0	0	4	0	0	2	2
Total—12	4	3	5	0	2	2	2	0	6	3	1	6	2

extension—who were found at cystoscopy to show intravesical invasion. On the other hand, the bladder may appear normal in the presence of broad ligament involvement sufficient to result in ureteral occlusion.

Among our 93 postmortem studies there were 10 patients who had had no treatment directed to their malignant disease. Seventy per cent of them had some degree of bladder involvement, one showed invasion of the vesical wall, in 3 there was extension into the mucosa, and 3 had vesicovaginal fistulas. Although this group is small, it will be seen that these figures closely parallel those already presented for the entire series.

A very interesting and important phase of this entire subject of bladder complications in carcinoma of the cervix, is presented by a condition which results from the treatment of this disease rather than from the disease itself. We refer to the remote radium reaction, a lesion unrecognized until relatively recently, and one which, until better understood, gave rise to considerable diagnostic confusion in these cases. The earliest descriptions were written by Haendly, Schugt, Zeiss, Kahn, and Dean, and more recent discussions of the subject have been published by Ottow, Smith, Colby, and others.

In general, it may be stated that there are two types of radiation reaction within the bladder. First there may be the early or acute reaction which occurs at the height of the radiation effect in the cervix itself. This is comparable to the mucosal changes seen often in the buccal cavity following external irradiation for malignant disease. The reaction in the bladder which may vary in degree, gives rise to the symptoms of cystitis that patients report so frequently soon after treatment. It is true, doubtless, as Ottow has said, that this acute process may subside or may advance to actual ulceration and even fistula as occurred in one case in our series.

The late or remote radiation reaction in the bladder is the more definite clinical entity and the one usually referred to in discussions of this subject. It is analogous to the skin changes with

which we are all familiar and to the radionecrosis that occurs sometimes, in tissues elsewhere in the body following massive irradiation. It results primarily from vascular changes which may vary in degree from mild transient interference with local blood supply, to complete obliterative endarteritis with ischemic necrosis. The lesion produced in the bladder, therefore, will depend upon the extent of these effects. Cystoscopic examination may find nothing more than a circumscribed area of hyperemia and edema, or there may be a zone of complete devitalization with ulceration and slough. The ultimate fate of the region involved will depend upon the depth of injury, and this may not be determined usually by a single cystoscopic inspection. It is probable that there is eventual healing in the greater number of cases, and that when healing occurs the mucosal and submucosal layers have been chiefly affected. It is reasonable that the minute arterioles, venules, and capillaries that supply these inner layers should be more susceptible to injury and more vulnerable to obliterative changes than the larger vessels nearer the bladder periphery. When, however, these larger vessels are involved in this process, the depth of necrosis in the vesical wall may be so great as to preclude the possibility of local recovery, and lead even to fistula.

In our series, there were 12 cases of late radiation reaction in the bladder (Table VI). The average length of time from the first radium treatment to the onset of bladder symptoms was 2.25 years. The shortest interval was 0.7 years, and the longest, 5.5 years. It is interesting and probably significant that three patients in this group had re-treatment with radium some time after the initial dose, and that for them the average time before the development of the vesical lesion was 1.1 years after the last treatment, the shortest interval was 0.5 years, and the longest, 1.5 years.

The symptoms, in our experience, consist chiefly of dysuria, hematuria, and increased frequency of micturition, usually of relatively acute onset. Such symptoms, reported long after the

treatment of the cervix and in patients free from local disease are highly suggestive of the presence of radiation reaction within the bladder.

The conditions found by cystoscopy will vary as we have stated. The most common picture is that of a central sharply defined area of slough surrounded by a zone of hyperemia and edema. The edema may present as minute blebs or raised reddened ridges. Obviously the radiation reaction will occur in the region of greatest radiation effect and its location in the bladder therefore need not be the same in all cases. The most frequent site as we have found it is in the posterior midline just above the trigone. The common involvement of this region is due in large measure probably to its anatomical location with reference to the cervix. We would suggest however that there may be another influence in the possibility of a less rich vascularity in the midline of an organ deriving its blood supply from main vessels which enter it laterally on each side.

Clinical differentiation between a late radiation reaction within the bladder and invasion by tumor is sometimes difficult and especially so when the lesion is first observed. Repeated examinations with reference to progression or regression usually are helpful but the decision cannot be made often by the cystoscopic picture alone. A history of radium treatment of the cervix followed by a prolonged interval of many months or even years before the appearance of the lesion in question weighs heavily in favor of the radiation reaction. The presence or absence of active disease in the pelvis cannot determine the diagnosis but freedom from palpable tumor argues of course against malignant invasion of the bladder. We have observed in some instances of radiation reaction that thickening perhaps edema and tenderness may be felt in the anterior vaginal wall opposite the area involved. In general it is our impression also that the urinary symptoms produced by late radium effect are more insistent and more acute than those arising from early invasion by tumor and that such symptoms when so produced usually subside quite satisfactorily with simple measures of local treatment continued until inspection with the cystoscope finds that healing is complete. Removal of tissue for biopsy may be resorted to but we do not believe that this should be necessary in most cases and we do not recommend it.

#### EVALUATION OF STUDY

There are certain general impressions to be derived from the foregoing text and tables which undoubtedly have much bearing on the involve-

ment of the bladder from carcinoma of the cervix and its treatment. It is quite obvious and well known that the more advanced the local disease the greater the likelihood of vesical invasion. It can be seen from perusal of the tables that the proportion of the early to the advanced cases in the group with negative cystoscopic findings is much greater than in the positive groups where the moderately advanced and advanced cases are overwhelmingly in the majority. The extent of disease therefore should offer a reasonable indication as to whether or not the bladder is involved. Generally speaking this may be true but as has been stressed before it is exceedingly difficult to determine the extent of disease by pelvic examination alone. For instance as has been emphasized by others a case which clinically presents evidence of broad ligament extension may have nothing more than carcinoma confined to the cervix and immediate paracervical region with an inflammatory process accounting for the lateral involvement. In contrast with this is the patient who on vaginal and rectal palpation does not reveal any parametrial change but in whom inspection of the bladder shows either suggestive or definite invasion of this organ by tumor thereby altering at once the original clinical concept. There is further confirmation in our postmortem series which as has been stated previously shows that the mode of dissemination of the disease varies considerably and may involve the bladder without any evidence of broad ligament extension. The reverse of course is also true. Cystoscopic examination therefore may be just as important as pelvic and pathological examinations in determining the true status of the case in question.

The relationship between the grade of carcinoma and intravesical invasion is difficult to evaluate since a single biopsy especially a superficial one does not always reveal the relative malignancy of the tumor. In general it may be said that the highly malignant neoplasms are more likely to extend into the bladder.

We would like to advance at this time the importance of the clinical type of tumor with respect to vesical invasion. If one considers the position of the cervix in relation to the bladder it can be seen that the liability to bladder involvement by tumor varies definitely with the nature of the growth. The proliferative type which is not infrequently of a lower grade of malignancy because of its bulky character is likely to produce at cystoscopy the picture of extra vesical pressure (Table II). Some tumors of this type extend into the bladder but submucous infiltration of the



vagina usually precedes this extension. When intracervical radium is used in this kind of lesion, the bulk of the tumor gives added protection to the bladder so that severe radiation reactions seldom occur. If radium seeds are introduced, such reaction when it does occur, depends entirely upon the proximity of the bladder to the site of the application.

The ulcerative type of growth is usually of higher malignancy and seems to possess a greater tendency to vesical invasion than the others. This can be easily understood when the character of its behavior is considered. It is distinctly destructive, and once the cervix is even partially destroyed, continuation into the bladder may follow more easily, producing in sequence, intramural and mucosal invasion, and finally fistula. This is illustrated by the frequency of this type of lesion in the untreated cases which show a high percentage of bladder involvement. It is in this type also that fistula may result from the application of radium, since the vesicovaginal septum is considerably thinned bringing the bladder closer to the site of radiation. It is possible also that in cases of actual vesical involvement by a radio-sensitive tumor, regression may occur so rapidly under treatment as to preclude the possibility of healing and so produce a fistulous communication with the vagina. It has been contended by some that radiation is the major factor in the production of fistulas. We recognize its importance but we agree with Cutler, Smith, and others, that the vesicovaginal fistula in carcinoma of the cervix, is usually a manifestation of progressive disease. The incidence in our living group is low, a fact which lends further evidence in addition to our postmortem statistics, that advancing disease is the predominant influence in fistula formation. Fistulas may be produced by radium, but as is stated by Cutler, the cause may lie not so much in the radium itself, as in faulty technique of application, with failure to keep applicators in proper position, or lack of sufficient packing against the bladder. Other factors of importance are inadequate filtration, excessive doses, and re-treatment with radium in an area which has had already irradiation to the limit of local tolerance.

The inverte or endocervical type seldom grows toward the bladder, but here too one may see evidence of tumor by cystoscopy or at autopsy (See Tables III and V B). This form of tumor is characteristically infiltrative and may remain confined to the cervix for a relatively long time before extending into neighboring structures. As will be seen by Table VI, this type predominates

in the cases with radiation reaction within the bladder. The intervening tissue offers greater protection than in the ulcerative form, but less than in the proliferative type of growth. The vesical changes due to radiation are usually late and seldom progress to fistula.

In every instance of late radium reaction in the bladder in our series, radium seeds—occasionally glass but usually gold—were used in the treatment of the cervix. (Intracervical silver applicators were used in conjunction with the seeds in some cases.) We believe this to be of great significance, since inadequate filtration and the site of insertion in the periphery of the growth, undoubtedly play the greatest part in the production of this sequela. It seems significant in this connection that we have observed no radiation reactions in those cases in which treatment has been given at Pondville since early in 1931. This corresponds with the time of the discontinuance of the use of gold seeds as a routine measure. Seeds are now employed only in the treatment of small areas of recurrence in the cervix or vaginal wall. An additional obvious factor in the problem may be the use of massive or excessive dosage.

Another group to be considered is that in which fistula developed in cases without disease, a considerable time after treatment. Our series includes 6 such cases, and the average lapse of time between the first treatment and the appearance of the fistula was 4 years. Two interpretations may be offered. First, the fistula may be the final manifestation of a radio-necrosis which could not heal because of irreparable damage to the blood supply in the bladder wall and vagina. This is in accord with the time element in the development of late radiation reactions, since our average interval before the appearance of such reaction in the bladder was 2.5 years, and a fistula might represent an end-stage of this process. In the case of fistulas which developed in the presence of active disease, the average time of appearance was 1.6 years after the first treatment, and 0.75 years after the last treatment. A second but less likely tenet is that scar which follows regression of tumor after treatment, and which involves both bladder and vagina, may disintegrate to the point of fistula with the advent of serious infection.

It has been found also in our series, that fistula or radiation reaction are more likely to occur in those patients who have had treatment for carcinoma of the cervical stump, sometime after supravaginal hysterectomy. The reasons for this are evident and need no further discussion at this time.

There is apparent lack of agreement in the published reports concerning the incidence of vesicovaginal fistulas in carcinoma of the cervix. The figures of Warren, Williams and Behney are in accord with ours. Smith, however, in presenting a large group of cases from the Memorial Hospital, stated that fistulas occurred with an average frequency of once in 98 patients (1 per cent). In his untreated group there was an incidence of 7.2 per cent, though in his opinion this figure may be too low to represent the actual incidence since there was no attempt to follow closely those cases in which the disease was too advanced to be amenable to radiation therapy. With respect to the treated group there may be several reasons for the wide difference in our figures. The ratio of the primary to the secondary or recurrent cases at the Memorial Hospital, estimated from Smith's data, was about 4.5 to 1, as compared to 1.8 to 1 at Pondville. Moreover, specific information concerning the extent of disease was not given. In our series about 80 per cent were classified as C or D cases. It can be seen that these two facts in themselves, indicating more advanced disease, may account for our higher percentage. The fistulas found at autopsy at the Memorial Hospital are not recorded, but it is probable that the figures would correspond closely to ours and those of others.

The difficulty of diagnosis in some instances in which the fistula is so small that it can be detected only by the introduction of dye into the bladder or by postmortem examination must be borne in mind. Furthermore, repeated examinations until death cannot be made in many cases. As we have shown, fistula is an ominous sign and patients so afflicted frequently fail to return to the hospital and remain at home for terminal care. The absolute incidence of vesicovaginal fistula cannot be given. We believe that the figures presented by Smith are too low.

#### CONCLUSIONS

In conclusion we believe that the bladder should be considered an integral part of the problem in carcinoma of the cervix because of the great frequency with which it is involved by the disease itself or as a result of treatment. We recommend cystoscopic inspection in the routine examination of all cases before instituting therapy and at intervals thereafter. By this means when the bladder is found to be normal a base line will be afforded for comparison with later observations as the case progresses. When on the other hand intravaginal invasion is found to have taken place the diagnosis as regards extent of disease

at once will be rendered more accurate and information of definite prognostic value will be obtained as well. It should be emphasized however that extension of disease into the bladder from the cervix should not be considered a deterrent to vigorous treatment of the malignant process. We have one unusual patient who had such extension even to the point of vesicovaginal fistula at the time of the first examination and who now, after treatment, presents no evidence of active carcinoma. The fistula remains of course but this is not too high a price to pay for successful cure.

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## THE ROENTGEN TREATMENT OF TUMORS OF THE BRAIN OR SPINAL CORD IN THE OPERATING ROOM BY DIRECT RADIATION THROUGH THE OPEN WOUND<sup>1</sup>

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**D**URING the past decade great progress has been made both in the surgical and the radiation treatment of infiltrating tumors of the central nervous system, but the combined results of surgery and radiotherapy still leave much to be desired.

Up to the present time the greatest advances in the surgical treatment of tumors of the brain have been in the meningiomas and other relatively benign and encapsulated growths. The results of operations upon infiltrating growths have also improved, but there are many problems which remain to be solved.

The protoplasmic and fibrillary astrocytomas, especially those which occur in the cerebral hemispheres, are often solid infiltrating growths, and in many instances the tumor is so extensive that even by the excision of an entire lobe all tumor tissue can not be removed.

When a glioma has undergone a cystic change and there is a discrete tumor nodule in the wall of the cyst, the evacuation of the cyst contents and the excision of the nodule has often given brilliant and lasting therapeutic results. This is especially the case in the cystic astrocytomas in the posterior cranial fossa that occur in childhood and early adult life. On the other hand, the astrocytomas that are found in the cerebral hemispheres are often solid growths and even if there are one or several large cysts, there is frequently no discrete tumor nodule. The solid part of the growth is often so large or so situated that it can not be completely removed. The statistics from a number of the neurosurgical clinics of this country, which were presented at a recent meeting of the Society of Neurological Surgeons, show that in many cases of supratentorial astrocytomas life is prolonged for only 2 to 3 years. In some instances the survival period after operation is as long when little tumor tissue has been removed as after a gross total excision of the neoplasm.

When we turn from the astrocytomas and other rarer types of infiltrating tumor of the cerebral hemispheres to the consideration of the rapidly growing and malignant glioblastoma multiforme, the picture is a still more gloomy one. The average length of life of a patient who has been operated upon for a multiform glioblastoma is often

less than 1 year. Only in rare instances have the patients survived for a considerable number of years.

A similar story must be told concerning the surgical treatment of the medulloblastomas in the posterior fossa of children. The vascular base of this type of growth can practically never be removed, and a survival period of more than 2 to 3 years is unusual. These growths are radio-sensitive and the results of suboccipital decompression to relieve obstructive hydrocephalus and roentgenotherapy without removal of the growth appear to be as good if not better than radical extirpation.

The results of the removal of tumors of the spinal cord are much superior to those obtained by operations upon tumors of the brain, due to the fact that so many of the growths are benign, encapsulated, and extramedullary or extradural. In primary extradural malignant disease radical extirpation of the growth is often impossible and only a small number of intramedullary tumors can be removed.

Therefore, in spite of the great advances that have been made, the best that can be accomplished by surgery in many tumors of the brain and some of the spinal cord is palliation and prolongation of life.

Most of the patients have received postoperative radiotherapy and the preceding statement applies to the results obtained by the combination of surgery and radiation therapy. It is not the purpose of the writers to discuss the subject of radiotherapy of tumors of the brain in detail, but to give a brief summary of the present status of the subject.

The use of roentgen radiation of tumors of the brain is based upon the known fact that the cells of many tumors are more radiosensitive than the normal brain or spinal cord. Opinions of roentgenologists differ regarding the sensitiveness to radiation of the various tumor types. That the medulloblastoma is very radiosensitive is well known, and the same is true of a certain number of solid pituitary adenomas. Although temporary clinical improvement after radiotherapy has been observed in many of the gliomas, there is little agreement on the question whether and to

what degree the cells of the tumors are affected by radiation. This subject was discussed in a symposium on radiotherapy of tumors of the brain at the meeting of the Association for Research in Nervous and Mental Disease in 1935. The various opinions there expressed may serve as a general summary of our present knowledge of the matter.

The conclusions of those who took part in the discussion were

1. Radiation has an undoubted effect upon many tumors of the brain.

2. The degree of effect is not known, because there have been too few careful histological studies of tumor tissue before and after radiation.

3. There is little exact knowledge of the relation of the amount of radiation used to the results observed.

4. Profound changes in the tumor cells may be produced by roentgen therapy.

5. With the methods hitherto used, adequate doses of roentgen-rays can not be given because of the danger of injury to the soft and bony tissues of the head.

6. In a large proportion of the patients, the roentgen-ray dosage was inadequate.

The main object of this article is to suggest a method of procedure for the roentgen-ray treatment of irremovable or partially removable tumors of the brain and spinal cord, with which adequate dosage should be possible.

About 3 years ago it occurred to one of us that the roentgen-ray treatment of tumors of the brain or spinal cord could best be accomplished by the direct radiation of the growth at the time of operation when the brain and the tumor were exposed. This would become possible as soon as (1) high voltage x-ray machines had been devised so that the necessary time of exposure would be greatly shortened, and (2) as soon as a method of procedure had been worked out in which the radiation could be introduced directly into the tissue of the tumor at the time of the operation.

When the shock-proof high voltage x-ray machines were put on the market, the first condition aforementioned was satisfied. We then endeavored to obtain financial support for the installation in the operating room, of a new machine of this type. This support was only recently obtained. With the co-operation of the Picker X-ray Corporation, the plans for the installation of a high voltage machine in the main operating room of the Neurological Institute were completed, and the methods by which the personnel in the operating room would be completely protected against secondary radiations were worked out in the

greatest detail. The machine has finally been installed and is ready for use.

In order to determine the maximum radiation to which the primate brain and spinal cord can be subjected without danger of injury to the nervous tissues, it is our purpose first to investigate carefully the effects of radiation on the exposed brains of monkeys. We have already subjected the brains of a few *Macacus rhesus* monkeys to prolonged radiation. All of the animals were under dial anesthesia. Under aseptic precautions a flap of the scalp was turned down, a large defect in the bone made with rongeurs and the dura widely opened. During the period of radiation, the exposed brain was covered with a piece of sterilized cellophane to prevent excessive drying and infection, and the remainder of the head and body protected by sterile leaded rubber sheets. After the radiation, the soft tissue flap was returned into place and the edges of the incision in the scalp united by Michel clips.

In one animal 2400 r units were given at one sitting directly into the exposed cerebellum and medulla. The monkey is apparently perfectly well more than 7 weeks after the operation and radiation. Another animal received 7200 r units in two equally divided doses one week apart into the left cerebral hemisphere. After these large doses, this monkey developed a complete right hemiplegia following the second radiation. Unfortunately, the animal died of a wound infection 5 days later. A third animal received 5400 r units in two doses into the left cerebral hemisphere and now, 14 weeks after the radiation, appears well except for a spasticity of the right upper extremity. These massive doses were given with an x-ray machine which could deliver only 20 r units in every minute. Therefore it was necessary to expose the animal's brain for from 2 to 3 hours at each sitting. This exposed the brain to an unnecessary amount of heat, drying, and risk of infection.

We propose to repeat these experiments with the new high voltage machine by which 60 r units per minute can be given. After a larger experience has been gained by animal experiments, it is planned to apply the method to human beings with irremovable tumors of the brain or spinal cord. Needless to say, great care and circumspection will be observed, and the effects of small roentgen-ray doses will be investigated before larger doses are used.

We have called this procedure "The Roentgen Treatment of Tumors of the Brain or Spinal Cord in the Operating Room by Direct Radiation Through the Open Wound." It will, of course,

require a long period of observation of the patients upon whom this procedure has been used before any statement can be made regarding the benefits and dangers of the direct radiation of the exposed tumor and brain. The sole object of this preliminary report is to call attention to a new method of procedure by which it is hoped that adequate radiation can be given directly into irremovable growths of the central nervous system and at the same time with a minimum of danger of injury to the soft and bony tissues of the head or trunk.

## SUMMARY

The deficiencies of present day methods are

- 1 The harmful effects to the skin and bone
- 2 The fact that the tumor receives much less radiation than the skin

The advantages of the proposed method are

- 1 The maximum radiation will be given into the tumor
- 2 The skin effects will be minimal.

Note—Since this paper was sent to the Editor May 25, 1936, an additional monkey has been exposed to the same dose and several patients with tumors of the brain have received the therapy.

# EDITORIALS

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DECEMBER, 1936

### TUBERCULOSIS OF THE BREAST

**T**UBERCULOSIS is one of the diseases to which the breast is not commonly subject but it cannot be considered rare. The incidence of tuberculosis of the breast in comparison with that of carcinoma of the breast, is respectively 1 case to 200 cases. There are two general types of tuberculosis of the breast. In the first, the disease is primary in the breast and in the second, it is secondary to tuberculous lesions elsewhere in the body.

Primary tuberculosis of the breast is rarely diagnosed clinically. The most common clinical diagnosis is carcinoma or purulent mastitis. The primary type of tuberculosis of the breast usually occurs in one of two forms: a diffuse form which may involve the greater part of the breast or a discrete form which is evidenced by a single tumor or by multiple tumors. In many instances it is impossible to distinguish tuberculosis from carcinoma of the breast, either by symptoms or by physical findings, for in the diffuse type of tuberculosis

of the breast the lesion is hard, is irregular in outline, often is associated with edema and closely simulates the diffuse inflammatory type of malignancy. In the discrete type of tuberculosis of the breast there is often associated adenopathy and fixation of the lesion to the overlying skin, often there is no pain. Some features, however, if present, lead to the suspicion that the lesion is tuberculous. Usually mammary tuberculosis afflicts young women and the tumor increases in size more rapidly than a carcinoma. Although a tuberculous tumor of the breast usually is large when the patient presents herself for examination, metastasis is absent, if such a large growth were malignant, extensive metastasis would be demonstrable by physical or roentgenologic examination. Discharge from the nipple is more commonly a feature of tuberculous than of carcinomatous lesions and the discharge from a tuberculous lesion is usually composed of pus-like material whereas that from a carcinoma is serous or bloody. Retraction of the nipple is present if a tuberculous lesion is situated in the central portion of the breast, but this sign is not as common as it is in the presence of malignant lesions nor is it as marked. If tuberculous lesions are of long standing, an abscess may form and ulceration may take place. In such cases, the diagnosis usually can be established by examination of smears of the pus but the patients usually present themselves for examination before abscesses have formed or ulceration has appeared. The diagnosis in cases in which there is no draining sinus must be established by microscopic examination of the tissue after removal of the tumor. The

treatment is surgical. I believe the most conservative operation for primary tuberculosis of the breast to be simple amputation followed by roentgen therapy applied over the regional lymph nodes. In some cases in which the process is extensive and in which the axillary nodes are extensively diseased complete axillary dissection will be required in addition to simple amputation. In cases in which the process is so extensive that the pectoral muscle and regional lymph nodes are involved radical amputation is necessary.

Tuberculosis of the breast secondary to tuberculous lesions elsewhere in the body is usually diagnosed clinically because the primary lesion is recognized. The breast may be invaded either by way of the lymphatic channels or by direct extension from an abscess in the thoracic wall to the tissue of the overlying breast. In many cases of this type there are draining sinuses and the diagnosis is easily established by examination of the pus. The surgical indication in cases of secondary involvement depends on the general condition of the patient and in many instances all that is justified is general heliotherapy or roentgen therapy. In cases in which tuberculous abscesses of the thoracic wall invade the tissue of the breast the best surgical treatment usually is simple amputation of the overlying breast and heliotherapy applied to the abscess or sinus of the thoracic wall.

STUART W. HARRINGTON

## ANESTHESIA AND SURGERY

FROM the beginning of time means have been sought for to allay pain and suffering. At first these attempts were crude and consisted mainly of pressure over blood vessels and veins and the application of cold. The search was not limited to medical

men. Through the ages progress was made and in 1561 the sweet oil of vitriol is described in the writings of Valerius Cordus collected by Gensler. The clinical use of ether had to await Long in 1841. The clinical art of anesthesia, the pharmacology and physiology of the anesthetic agents in use, was developed. This whole field was then placidly neglected by the medical profession except for the sporadic efforts of individuals. These individuals contributed the advances that were made to anesthesia up to the last two decades. Since that time the medical profession has again taken up anesthesia.

This placidity on the part of the medical profession was undoubtedly due to several factors. First the anesthetic agents were one hundred per cent potent, covered every possible case, and with ether there was a wide margin of safety. In the second place this potent anesthetic opened up the field of surgery so that surgeons were primarily interested in exploring these fields. The third factor was that these new fields served to occupy the attention not only of the surgeons but other fields of medicine and anesthesia because it got by, had to wait.

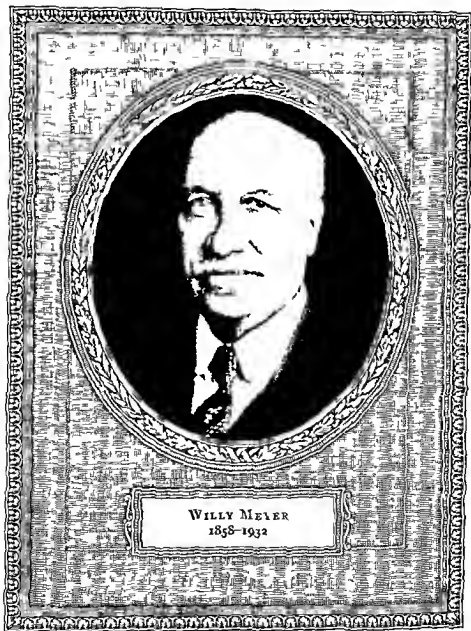
With this renewed interest on the part of medical men in anesthesia their work has resulted in advances in the science and the art. It has advanced so that the field of knowledge is so wide and its application in the clinical field so extensive that what has happened to anesthesia is the same story found in the other specialties of medicine and surgery.

To further the development close co-operation is an absolute necessity for progress. The anesthetist needs the co-operation of the surgeon and the surgeon needs to understand this newer anesthesia so as to be able to give the patient the best possible service.

ERWIN R. SCHMIDT







WILLY MEYER  
1858-1932



gery and feeling definite inclinations along that line he soon devoted himself to that specialty. Beginning as an assistant in the surgical department of the German Dispensary he rapidly rose to fame and was appointed to one important position after another. From 1886-1893 he was professor of surgery at the Woman's Medical College. In 1886 he was appointed attending surgeon at the New York Skin and Cancer now the Stuyvesant Square Hospital where he remained active until 1902. The longest periods of active service were devoted to the German now the Lenox Hill Hospital and to the New York Post Graduate Medical School and Hospital. In the former he served from 1886 until his retirement due to the age limit in 1923 while in the latter he served as attending surgeon and professor of surgery.

During more than 40 years of active practice one surgical problem after another engaged his attention and he never rested until he had mastered them. His early period of training fell into the important years when Lister's principles of antiseptic surgery were first applied. Then came the rapid advances of modern surgery based on this new knowledge and Willy Meyer's work and his writings are intimately associated with this entire development.

Of his numerous contributions to the literature the first important one to attract general attention was the technique for the radical operation for cancer of the breast published in 1894. Then came articles dealing with cysto-cop, urological surgery, modern gastric surgery, acute appendicitis and many others.

There probably is no branch of surgery which did not engage the attention of Willy Meyer and about which he did not make some contribution to the literature. His mind was ever active and alert and everything new which promised relief to suffering humanity was tried by him. The entire development of thoracic surgery in this country is intimately connected with his name. His was pioneer work in the true sense of the word for in addition to the surgical problems involved physical difficulties connected with pneumothorax had to be overcome. It took years of experimental work at the Rockefeller Institute followed by its practical application in the thoracic pavilion of the German Hospital which helped to lay the foundation for thoracic surgery in America. Dr. Meyer was the founder of the New York Society for Thoracic Surgery as well as of the American Association for Thoracic Surgery.

During his entire professional life he was intensely interested in the subject of cancer. It found expression in the development of the radical operation for cancer of the breast in numerous articles on the subject and finally in his last great work, his book called *Cancer* published in 1931. It speaks of the origin and development of cancer and deals with the therapy of operable and inoperable cancer in the light of a systematic conception of malignancy.

Willy Meyer's great activity has been of value not alone to the public but to the younger men in the profession. He reached many through his writings



# LANDMARKS IN SURGERY

## CHARLES BELL AND FACIAL PALSY

HARRY A. PASKIND M.D. CHICAGO ILL. U.S.

CHARLES Bell who possessed in such full measure the qualities of surgeon, investigator, philosopher, artist and poet was born in Edinburgh in November 1774. For 500 years there had been among his ancestors many men of learning and distinction. This strain of intellectuality found its fullest expression in Charles Bell and his brothers. The oldest of these Robert became the author of the Scotch law dictionary the next John was to become the celebrated surgeon the third George Joseph was to be elected professor of law in the University of Edinburgh and Charles was destined for accomplishments of such splendor and magnitude as to lead to perpetual fame and renown.

In later years, referring to his early education he wrote "I received no education but from my mother neither reading, writing ciphering nor any thing else. My education was the example set me by my brothers there was in all the members of my family a reliance on self—a true independence—and by imitation I obtained it. People prate about education and put out of sight example which is all in all."

John Bell his brother had gained a reputation as an anatomist and surgeon he decided to take Charles under his tutelage and teach him the elements of anatomy and of surgery and at the same time allow him to take courses at the University of Edinburgh. Here the youthful Charles fell under the influence of some of the unusual men on the faculty of Edinburgh University that day. Of these probably the most striking was Dugald Stewart a man of magnetism and sound intellect who occupied the chair of philosophy. Young Bell also studied with Black who succeeded the great Cullen as professor of chemistry and who was called by Foulcroy the Nestor of chemical revolution. At the University Bell also fell under the influence of Alexander Monro the celebrated anatomist and James Gregory the internist

who as a teacher was conspicuous for a sound practicality and who often brought forward the maxim

The best physician is he who can distinguish what he can do from what he cannot do. During this period Bell was coached by David Allan the artist who helped Bell develop his ability to draw a talent which was first observed and nurtured by his mother.

In 1789 while still an undergraduate he published his *System of Dissections* with plates engraved from his own sketches and wrote the description of the nervous system in John Bell's *Anatomy of the Human Body*.

On August 1, 1790 Charles Bell having completed his course at the University was admitted to the Edinburgh College of Surgeons and immediately afterwards he was appointed to the surgical staff of the Royal Infirmary the only hospital in Edinburgh. Here he soon became known for his remarkable skill as an operator, dexterity, simplicity, originality and dispatch characterized his work. At this period he began to model pathological specimens in wax and soon had an extensive collection of which some remarkable specimens may even at the present time be seen in the museum of the College of Surgeons in Edinburgh.

After an altercation with Gregory Charles Bell and his brother were not reappointed to the infirmary. Charles decided that Edinburgh afforded him no present opportunity and he left Edinburgh to pursue his career in London.

On a Sunday late in November of 1804 Charles Bell arrived in London. It was a disgruntled defeated home sick Bell that stalked the streets of London on that Sunday. Regarding his first day's experiences in London he wrote "If this be the season that John Bull selects for cutting his throat Sunday must be the day for then London is in all its ugliness all its naked deformity the houses are like ruins and the streets deserted."

During the early period of his life in London the only encouragement that he received was an



SIR CHARLES BELL  
1774-1841

invitation to join the Anatomical Society The London anatomists, having heard of him through his "Dissections" and his chapters in John Bell's *Anatomy*, invited him to join their society This served to acquaint him with the most prominent English anatomists of that day—Cline, Cooper, Abernethy, Home, Wilson, Baillie, and Blizard, and although their reception of Bell was at first lukewarm and condescending they soon became his friends These new friendships encouraged him but little, for at this time he wrote to his brother "I can make a few good friends, but I cannot engage the multitude" Gratifying as was his membership in the Anatomical Society it still left him without a place to work

Unable to find an opening in an institution already established, Bell decided that he had to found one of his own So on January 20, 1806, he took a house on Leicester Street, Leicester Square, and fitted it up as a lecture room and living quarters, and decided to establish himself as a lecturer

Bell's lectures met with unqualified success, and his fame as a lecturer spread rapidly throughout London, more pupils were attracted and more patients sought him out By 1808 he had thirty-six paying pupils while the professor at the Royal College of Surgeons had only four

In 1812 Wilson offered him a partnership in the Great Windmill-Street Medical School The school was founded by the Hunters, and was the scene of their great success Bell accepted this offer with alacrity His anatomical and pathological preparations and his drawings were added to the collection already there, much to his joy His first lecture in this school was attended by 100 pupils

Honors now came thick and fast Bell was admitted to the Royal College of Surgeons in 1813 The next year he was elected surgeon to the Middlesex Hospital, and he early began to make great use of the opportunities that this hospital afforded His lectures and operations here were attended by students and eminent practitioners, his practice now grew very rapidly

Bell was appointed professor of anatomy in the Royal College of Surgeons in 1824 By this time his fame became so widespread that his lectures were crowded to suffocation From 1827 to 1830 he took a prominent part in the founding and development of the University College (now London University), but here he was allowed insufficient freedom, and he resigned from the College in 1830 In 1831 he was conferred the honor of knighthood upon order of Guelphic knighthood was conferred upon him and he became Sir Charles Bell In 1835 the Council of Edinburgh elected Sir Charles to the chair of surgery at Edinburgh University, he accepted the offer and that year returned to the scene of his early labors

Bell entered London in 1804, unknown, ignored, almost insolvent, and a Scotchman (a word almost opprobrious in the London of the day), and he left London in 1835, famous, sought after, highly solvent, and an English knight His rise was due in part to his brilliance as a lecturer, anatomist, and

surgeon, but infinitely more to the brilliant discoveries forever to be associated with his name

In 1811 he published *A New Idea of the Anatomy of the Brain* In this work he relates an experiment performed on an ass in which irritation of the posterior root caused pain and irritation of the anterior root convulsion of the muscles of the back "I now see," he writes "the meaning of the double connection of the nerves with the spinal marrow"

In 1813 Bell concluded that strabismus ought to be relieved surgically by cutting the nerve to the intact muscle responsible for the deviation of the eyeball He had his assistant, Shaw, look all over London for a cross-eyed monkey Bell could not be induced to make this first experiment on a human being Shaw brought back a monkey but it was not cross-eyed In default of a squinting monkey, Bell decided to try section of the facial nerve on this animal DuBois d'Amiens describes this event as follows, "The poor animal began to grimace with redoubled energy, but entirely on one side of his visage, the other remaining quite motionless No one, assuredly, could have thought of practicing this experiment upon a human being, but nature took it upon herself All who were admitted to see the monkey operated on by Charles Bell, were struck with the strange analogy its physiognomy presented with that of an old actor then high in repute in London, who could at pleasure express every variety of passion on one side of his face, while the opposite half exhibited no emotion whatever Charles Bell's experiment supplied him with a clue to the enigma It was found that this comedian, struck by facial hemiplegy, in consequence of an accidental injury to the motor nerve, simply availed himself of a natural infirmity" This was the accouchement of the expression, "Bell's palsy," a term applied today to paralysis produced by peripheral lesion of the facial nerve

In 1806 he published *The Anatomy of Expression*, a book widely read by physicians and used as a text by artists One year later appeared his *Operative Surgery*, and in 1810 *Disease of the Urethra Engravings from Specimen of Morbid Parts* was published in 1813, and in 1814 he wrote a work on gunshot wounds Then appeared in rapid succession his *Surgical Observations, Essay on the Forces which Circulate the Blood, and Observations on Injuries of the Spine*

Sir Charles Bell returned to Edinburgh in 1835 Edinburgh did not, however, give him the satisfaction that he had hoped for, although his classes there were successful Practice in Edinburgh did not yield what it did in London and the honorarium at the University did not make up for this deficiency His fellow professors were somewhat cold to him, he interpreted this as Scotch undemonstrativeness and not as "jealousy" "I have a German professor to breakfast," he wrote at this time, "who brings me a volume from Paris—they make me greater than Harvey I wish to heaven the folks at home would make something of me"

On April 27 1842 Sir Charles and Lady Bell stopped at Hallow Park the country seat of his friends Mr and Mrs Holland near Worcester Here he enjoyed the scenery and made several sketches of the yew trees in the vicinity That day he said to his wife This is a novel spot here I would rest till they come to take me away After dinner the same evening he sketched various medical celebrities of his acquaintance admired and discussed Leonardo da Vinci's Last Supper In a happy mood he said to his wife Did you ever see me happier or better than I had been this forenoon? These remarks were evidently intended to keep his wife from worrying because that day he had had several paroxysms of anginal pain and that very evening his face became pale several times Before bedtime he read aloud the Twenty Third Psalm then retired and fell into a deep quiet sleep In the morning he awoke with severe pain which he said was due to changing his position His wife arose to give him some laudanum Calling her to him he laid his head on her shoulder and died

No more fitting tribute has been paid to Sir Charles Bell than that in the *Edinburgh Review* for April 1872 Never passed away a gentler truer or finer spirit His genius was great and has left a

legacy to mankind which will keep his name fresh in many generations But the story of his life has a more potent moral It is the story of one who kept his affections young and his love of the pure unsullied while fighting bravely the battle of life whose heart was as tender as his intellect was vigorous and original who while he gained a foremost place amongst his fellows turned with undiminished zest to his home and his friends and found there the object the reward and the solace of his life

Sir Charles was buried near a yew tree that he had sketched a few days before in Hallow Churchyard At first a plain stone with his name dates of birth and death and the line The pure in heart shall see God marked the spot Afterward a tablet was placed in the churchyard with an inscription by his lifelong friend and schoolmate Francis (Lord) Jeffrey It reads Sacred to the memory of Sir Charles Bell who after unfolding with unrivalled sagacity patience and success the wonderful structure of our mortal bodies esteemed lightly of his greatest discoveries except only a they tended to impress himself and others with a deeper sense of the infinite wisdom and ineffable goodness of the Almighty Creator



# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE two volume work entitled *Operative Gynecology*<sup>1</sup> written by H v Peham and J Amreich has been translated into English by L Kraeer Ferguson, of the University of Pennsylvania. It includes a charming foreword from the pen of the late Dr George Gellhorn who writes "we have been greatly in need of a treatise on operative gynecology which would be a worthy successor to Kelly's classic of 35 years ago. An operative gynecology should impart the three essential requisites of a good surgeon—a sound anatomic knowledge, technical skill and refinement of execution and wise surgical judgment."

The first volume of 245 pages is divided into two parts, "a description of the methods and materials which are essential to a successful performance of all gynecologic operations and the surgical anatomy of the female pelvis." In the second volume various gynecological operations are described and illustrated in detail throughout their several steps. The results of some of the authors' investigative studies as well as statistical compilations from their own experiences are here recorded for the first time. They preferred to report these data in their text rather than crowd them into periodicals even though such a policy has sometimes cost them priority in the literature.

In the first portion of volume 1 the following subjects are considered: asepsis and antisepsis, anesthesia, postoperative complications and their prevention, hemorrhage and hemostasis, opening the abdomen, and finally pre-operative and postoperative treatment in gynecological surgery. In the second portion, on the anatomy of the female pelvis, the authors consider pelvic connective tissue, the ureter, arteries of the genital system, arteries of the rectum, veins of the genitalia, the lymphatics of the pelvic organs, and nerves.

In volume 2 one finds a discussion of the indications for operation and the choice of procedure in various types of pelvic pathology. Next the authors describe and handsomely illustrate the detailed technique of the various operations which they employ and finally each chapter is concluded by a statistical resume of their own personal experiences and end-results after utilization of the operations as described. The following lesions are considered: carcinoma of the cervix, carcinoma of the body of the

uterus, myoma, extra-uterine pregnancy, pelvic inflammatory disease, tuberculosis, ovarian tumors, prolapsus, retroversion, complete perineal tear, aplasia of the vagina, bladder and ureteral fistulas, rectovaginal and rectovesicovaginal fistulas, sphincter weakness with incontinence, Bartholin cyst, kraurosis vulvae, carcinoma of the vulva, and appendicitis.

As one reads these volumes and studies the illustrations he is impressed that the authors are original in their presentation. They describe only those procedures which they employ and they attempt to justify their choice of operations by citing the results which have been obtained in their own patients. They are thorough and explicit in every description, being convinced of the pedagogical soundness of repetition, this characteristic of their style of presentation was not at all disturbing. The illustrations are the forte of this text—they appeal to the eye, they are accurate and detailed, they are original and they are offered in such profusion that the anatomy of the female pelvis and the details of operations are unfolded in an enviable and enlightening manner.

Peham and Amreich's *Operative Gynecology* is an enduring contribution to our gynecological texts and books of reference. It contains a wealth of information for every gynecologist, young or experienced, look and see for yourself. It should grace the library of every surgeon who operates for pelvic pathology because of its lucid presentation of pelvic anatomy. Finally, no surgeon can afford to be deprived of immediate access to the illustrations of the abdominal and vaginal operations for cancer of the cervix, or the operation for cancer of the vulva.

GEORGE H GARDNER

VOLUME VII of *Pathologie und Klinik in Einzeldarstellungen*<sup>2</sup> is an important study of cretinism by the professors of surgery and pathology of the University of Bern. The work of these men in the center of the Swiss goiter area has fitted them by years of first hand clinical and pathological experience with cretins to render an authoritative account. Wegelin discusses the history and endemology. DeQuervain describes the clinical findings in general and, in detail, the changes found in the various systems of the body. Wegelin, from an extensive pathological material, presents the anatomy

<sup>1</sup>OPERATIVE GYNECOLOGY. By H v Peham and Dr J Amreich. With introduction to the edition in English by George Gellhorn, M.D. Authorized translation made by L Kraeer Ferguson, M.D. Vols 1 and 2. Philadelphia, Montreal, and London: J B Lippincott Company, 1934.

<sup>2</sup>PATHOLOGIE UND KLINIK IN EINZELDARSTELLUNGEN. Edited by L Aschoff, H Elias, H Eppinger, C Sternberg, K F Wenckebach. Band VII. Der endemische Kretinismus. By Prof Dr F de Quervain and Prof Dr C Wegelin. Berlin and Vienna: Julius Springer, 1936.

of all of the tissues DeQuervain reviews the pathological physiology of protein mineral and carbohydrate chemistry respiratory metabolism blood and blood cell changes the blood proteins iodine excretion and blood iodine liver function and thyroid function The authors combine in presenting a

study of the pathogenesis of cretinism This interesting chapter analyzes the importance of various factors in the production of cretinism—the distinction between athyreosis and cretinism is stressed. Every student of thyroid disease should have this valuable presentation  
PAUL STARR

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment is to be regarded as a sufficient return for the courtesy of the sender. Sections will be made for review in the interests of our readers and as space permits.

**THE OXFORD MEDICINE** By various authors. Edited by Henry A. Christian, A.M. M.D. LL.D. Sc.D. (H.) V.L. 7. PSYCHIATRY FOR PRACTITIONERS New York Oxford University Press 1936

**PROCTOLOGY: A TREATISE ON THE MALFORMATIONS, INJURIES AND DISEASES OF THE RECTUM, ANUS AND PELVIC COLON** By Frank C. Yeomans, A.B. M.D. F.A.C.S. M.R.S.M. (London) Second New York and London D Appleton Century Co. 1936

**TEXTBOOK OF SURGICAL NURSING** By Mabel A. Wylie Keller B.S. R.N. 3d revised New York The Macmillan Co. 1936

**THE EMANCIPATOR: AN HISTORICAL DRAMA** In Three Acts. By M. J. G. John Macgregor and John C. B. CMG and R. S. Antill and Warren Sydney Angus & Robertson Ltd. 1936

**DISEASES OF THE AIR AND FOOD PASSAGES OF FOREIGN BORN ORIGIN** By Chester Jackson M.D. S.D. F.A.C.S. LL.D. and Chester L. Jackson A.B. M.D. M.Sc. (Med.) F.A.C.S. Philadelphia and London W. B. Saunders Co. 1936

**THE FOSS OF MAMMALS** By George Pincus New York The Macmillan Co. 1936

**A TEXTBOOK OF OBSTETRICS** By Edward A. Schmaon A.B. M.D. F.A.C.S. Philadelphia and London W. B. Saunders Co. 1936

**TRAJECTORYS OF THE PACIFIC COAST SOCIETY OF OBSTETRICS AND GYNECOLOGY** Year 1935 Edited by Albert M. Thuermer M.D. Portland Oregon The Westman Journal 1935 1936

**THE CLINICAL USE OF DIGITALIS** By D. W. L. ten A.B. M.D. Springfield Illinois and Baltimore Maryland Charles C. Thomas 1936

**USES OF THE TESTICLE** By Hamish B. J. F.R.C.S. (Eng.) London H. K. Lewis & Co. Ltd. 1936

**ROGENTEN INTERPRETATION: A MANUAL FOR STUDENTS AND CITIZENS** By George W. Holmes M.D. and Howard E. Ruggles M.D. 5th edition Philadelphia Lea & Febiger 1936

**UROLOGY FOR NURSES** By Oswald Swinnery Lowrey M.D., F.A.C.S. and T. J. Arvin M.D. F.A.C.S. Philadelphia and Montreal J. B. Lippincott Co. 1936

**ATOMY OF THE HUMAN BODY** By Henry Gray F.R.S. 35d edition thoroughly revised and re-edited by W. R. H. Lee B.S. M.D. Philadelphia Lea & Febiger 1936

**LIVE LONG AND BE HAPPY, HOW TO PROLONG LIFE AND ENJOY IT** By Lewellyn F. Barker M.D. New York and London D Appleton Century Co. 1936

**THE 1936 YEAR BOOK OF RADIOLOGY** Diagnostics Edited by Charles A. Waters, M.D. Associate Editor: Whitman B. Frior M.D. TECHNICAL EDITOR: Edited by Ira L. Kaplan, B.Sc. M.D. Chicago The Year Book Publishers Inc. 1936

**OXFORD MEDICAL PUBLICATIONS. PSYCHIATRY FOR PRACTITIONERS** By various authors. Edited by H. H. A. Christy A.M. M.D. LL.D. Sc.D. (Hon.) (Reprinted from Oxford Loose-Leaf Medicine) New York Oxford University Press 1936

**MOTHER AND BABY CARE IN PICTURE** By Louise Zahnske R.N. Philadelphia Medical and London J. B. Lippincott Co. 1936

**OXFORD MEDICAL PUBLICATIONS. PAGET'S DISEASE OF THE NIPPLE AND ITS RELATION TO SURFACE CANCERS AND PRECANCEROUS STATES IN GENERAL** By E. H. Paget M.D. Ch. M. (Sydney) London Oxford University Press 1936

**THE INTELLIGENT FUNCTION OF THE FRONTAL LOBES: A STUDY BASED UPON OBSERVATION OF A MAN AFTER PARTIAL BILATERAL FRONTAL LOBECTOMY** By Richard M. B. Loefer B.S. M.D. New York The Macmillan Co. 1936

**CLINICAL STERILIZATION: A REEVALUATION OF THE PROBLEM** By The Committee of the American Eugenic Association for the Investigation of Eugenic Sterilization New York The Macmillan Co. 1936

**UROLOGY** By Edward L. A. Jones Ph.D. F.A.C.S. F.R.C.S. (Hon. L.R.) and Russell S. Ferguson A.B. M.D. 6th edition New York and London D Appleton Century Co. Inc. 1936

**TEXTBOOK OF GENERAL SURGERY** By W. H. Cole M.D. F.A.C.S. and Robert Ellman M.D. New York and London D Appleton Century Co. Inc. 1936

**MODERN UROLOGY IN ORIGINAL CONTRIBUTIONS BY AMERICAN AUTHORS** Edited by H. H. Cabot M.D. LL.D. CMG F.A.C.S. Vol. 1. GENITAL CANCER AND TUMORS—DISEASES OF THE PENIS AND URETHRA—DISEASES OF THE TESTIS—DISEASES OF THE PROSTATE—DISEASES OF THE SEMINAL VESICLES—DISEASES OF THE BLADDER—DISEASES OF THE URETER—DISEASES OF THE ADRENAL GLANDS—THERAPY OF TUMORS OF THE GENITOURINARY TRACT 3d edition Philadelphia Lea & Febiger 1936

**A TEXTBOOK OF SURGERY** By John H. Mann, M.D. 4th edition Philadelphia and Baltimore Maryland Charles C. Thomas 1936

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